

PROCEEDINGS

# APIEM APIEMS 2014

The 15th  
Asia Pacific Industrial Engineering  
and Management Systems Conference

> October 12~15, 2014

> Ramada Plaza Jeju Hotel, Jeju, Korea

APIEMS 2014 Information

Detailed Program

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EXIT



# Message from the APIEMS President



Greeting and a warm welcome to the participants of the 15th Asia Pacific Industrial Engineering and Management Systems Conference. Started in 1998, APIEMS has grown to become the premier conference for industrial engineering and management systems in the region with participants from all around the world. The main theme of this year conference: “Sustainable Industrial Systems and Big Data Management”, is an attempt to address the balance among economic and technical development, social development, and environmental protection in this fast changing world.

I congratulate and thank Prof. Dr. Chi-Hyuck Jun, the conference chair, whose leadership made this APIEMS 2014 conference possible. We are also grateful for the enthusiastic support of APIEMS from the KIIE and the Korea research community.

On behalf of the Asia Pacific Industrial Engineering and Management Society, I wish you a successful conference with many thoughtful discussions and debates with old and new friends.

A handwritten signature in blue ink, which appears to read 'V. Kachitvichyanukul'. The signature is fluid and stylized, with a long horizontal stroke at the end.

Professor Voratas Kachitvichyanukul  
APIEMS President, (2013-2014)  
Professor of Industrial & Manufacturing Engineering  
Dean, School of Engineering and Technology  
Asian Institute of Technology, THAILAND

# Message from the General Chair



Welcome to APIEMS 2014 in Jeju City, a beautiful island located at the most south of Korea. It is our great pleasure to organize this conference, which is supported by Korean Institute of Industrial Engineers (KIIE). APIEMS conferences have rapidly emerged as an important forum for exchange of ideas and information about latest developments in the field of industrial engineering and management systems among professionals mostly from Asia-Pacific countries. APIEMS 2014 conference encourages contributors to address the topical theme: Sustainable Industrial Systems and Big Data Management. Papers will represent the latest academic thinking and successful case examples. The wider audience will benefit from the knowledge and experience of leading practitioners and academics in this area.

The conference seeks research contributions from researchers, educators, modelers, software developers, users and practitioners. We hope that you enjoy participating in APIEMS 2014 and staying in Jeju.

A handwritten signature in black ink that reads "Chi H. Jun". The signature is written in a cursive, flowing style.

Professor Chi-Hyuck Jun  
General Chair, APIEMS 2014  
Industrial & Management Engineering  
POSTECH, Korea

# Conference Committee Members

## Conference Committee

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- Jinwoo, Park (Seoul National Univ., Korea)
- Katsuhiko Takahashi (Hiroshima University, Japan)
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and Management Science Society**



**THE KOREAN OPERATIONS RESEARCH  
AND MANAGEMENT SCIENCE SOCIETY**

# Keynote Speech

## **Keynote Speech I** **Research Issues in Future Logistics**

***Oct 13 (Monday) 11:00-12:00***

***Room: Ramada-1***

### **Chung– Yee Lee**

Hong Kong University of Science and Technology, China



Dr. Chung-Yee Lee is Chair Professor/Cheong Ying Chan Professor of Engineering in the Department of Industrial Engineering & Logistics Management at Hong Kong University of Science and Technology. He served as Department Head for seven years (2001- 2008). He is also the Founding and Current Director of Logistics and Supply Chain Management Institute. He is a Fellow of the Institute of Industrial Engineers in U.S. and also a Fellow of Hong Kong Academy of Engineering Science. Before joining HKUST in 2001, he was Rockwell Chair Professor in the Department of Industrial Engineering at Texas A&M University. He worked as a plant manager and also had few years consulting experience in Taiwan. In the past thirty years he has engaged in more than forty research projects sponsored by NSF, RGC, ITF, IBM, Motorola, AT&T Paradyne, Harris Semiconductor, Northern Telecom, Martin Marietta, Hong Kong Air Cargo Terminal, Hongkong International Terminal, Philips Medical, ...,etc.

His search areas are in logistics and supply chain management, scheduling and inventory management. He has published more than 130 papers in refereed journals. According to an article in Int. J. Prod. Eco. (2009), which looked at all papers published in the 20 core journals during last 50 years in the field of production and operations management, he was ranked No. 6 among all researchers worldwide in h-index.

He received a BS degree in Electronic Engineering (1972) and a MS degree in Management Sciences (1976) both from National Chiao-Tung University in Taiwan. He also received a MS degree in Industrial Engineering from Northwestern University (1980) and PhD degree in Operations Research from Yale University (1984).



# Keynote Speech

## **Keynote Speech II Data-Driven Decision Making in Manufacturing: Lessons Learned and Future Opportunities**

***Oct 14 (Tuesday) 11:00-12:00***

***Room: Ramada-1***

### **Ronald G. Askin**

Arizona State University, USA



Ronald G. Askin, Ph.D., is a Professor of Industrial Engineering and Director of the School of Computing, Informatics, and Decision Systems Engineering at Arizona State University. Professor Askin received his B. S. in Industrial Engineering from Lehigh University followed by an M.S. in Operations Research and PhD in Industrial and Systems Engineering from the Georgia Institute of Technology. He has over 30 years of experience in the development, teaching and application of methods for systems design and analysis with particular emphasis on production and material flow systems. Other interests include quality engineering and decision analysis. He has published over 120 journal and conference proceedings papers in these areas.

Dr. Askin is a Fellow of the Institute of Industrial Engineers (IIE) and serves as Editor-in-Chief of IIE Transactions. He has served on the IIE Board of Trustees, as President of the IIE Council of Fellows, Chair of the Association of Chairs of Operations Research Departments (ACORD) Chair of the Industrial Engineering Academic Department Heads (CIEADH) and President of the INFORMS Manufacturing and Service Operations Management Society (MSOM). He was also General Chair of the 2012 INFORMS Annual Conference. His list of awards includes a National Science Foundation Presidential Young Investigator Award, the Shingo Prize for Excellence in Manufacturing Research, IIE Joint Publishers Book of the Year Award (twice), IIE Transactions on Design and Manufacturing Best Paper Award (twice), the Eugene L. Grant best paper award from The Engineering Economist, and the IIE Transactions Development and Applications Award.



# Keynote Speech

## **Keynote Speech III Big Data Management**

***Oct 14 (Tuesday) 13:00-14:00***

***Room: Ramada-1***

### **Sungzoon Cho**

Seoul National University, Korea.



Sungzoon Cho is currently professor of Industrial Engineering Department, the director of Data Mining Center at Seoul National University (SNU) and a member of Government 3.0 Committee of Korean government. He is on the editorial board of International Journal of Operations Research and Information Systems and International Journal of Cognitive Biometrics. He served as the president of Hyundai Motors, Hyundai Heavy Industries, POSCO, Daewoo Shipbuilding and Marine Engineering, LG Electronics, Doosan Infracore, SK Hynix, SK Telecommunication and CJ. He advised nine PhDs and 56 Master students. He teaches Data Mining and Computational Intelligence at SNU as well as at firms. He received BS and MS in Industrial Engineering at SNU. He won a Fulbright Scholarship to obtain Masters and PhD at University of Washington in Seattle, US, and University of Maryland in College Park, US, respectively.

# Conference at a Glance

Oct 12 (Sunday)		Oct 13 (Monday)		Oct 14 (Tuesday)		Oct 15 (Wednesday)	
		08:00-17:00	Registration	08:00-17:00	Registration	08:00-12:00	Registration
		08:30-10:10	Technical sessions MA	08:40-10:40	Technical sessions TA	08:30-10:10	Technical sessions WA
		10:10-10:30	Coffee break			10:10-10:30	Coffee break
10:00-18:00	Registration	10:30-11:00	Opening addresses : APIEMS President, KIIIE President, General Chair			10:30-12:10	Technical sessions WB
		11:00-12:00	Keynote speech I (Prof. Chung-Yee Lee: Research issues in Future Logistics)	10:40-11:00	Coffee break		
				11:00-12:00	Keynote speech II (Prof. Ronald Askin: Data-Driven Decision Making in Manufacturing)		
13:00-17:20	Excursion	12:00-13:30	Lunch	12:00-13:00	Lunch	12:10-13:30	Lunch
		13:30-15:30	Technical sessions MB	13:00-14:00	Keynote speech III (Prof. Sungzoon Cho: Big Data Management)		
				14:00-14:20	Coffee break		
		15:30-15:50	Coffee break	14:20-16:00	Technical sessions TB		
		15:50-17:50	Technical sessions MC	16:00-16:20	Coffee break		
	Registration			16:20-18:00	Technical sessions TC		
18:00-20:00	Welcome Reception			13:00-18:00	Poster Session		
				18:30-21:00	General Reception		

Oct 12 (Sunday)									
10:00-18:00	Registration								
13:00-17:20	Excursion								
18:00-20:00	Welcome Reception								
Oct 13 (Monday)									
08:00-17:00	Registration								
Room	Mara	Biyang	Udo	Chuja	Ramada-1	Ramada-2	Ramada-3	Ramada-4	Halla(8F)
08:30-10:10	Technical sessions MA								
	MA1	MA2	MA3	MA4	MA5	MA6	MA7	MA8	MA9
Session name	Data Mining 1	Management of Technology and Innovations 1	ERP/ E-Business	Service Sciences 1	Quality Engineering & Management 1	Production and Operations Management 1	Metaheuristics	Financial Models & Engineering	Uncertainty Theory (Session I)
Paper #	528	100	37	54	23	75	42	41	551
	207	111	38	55	28	158	43	146	555
	276	143	352	108	109	211	175	180	556
	324	44	360	215	113	269	353	267	584
	296	97	255	244	226	213	465	273	
10:10-10:30	Coffee break								
10:30-11:00	Opening addresses: APIEMS President, KIIE President, General Chair								
11:00-12:00	Keynote speech I (Prof. Chung-Yee Lee: Research Issues in Future Logistics)								
12:00-13:30	Lunch								
13:30-15:30	Technical sessions MB								
	MB1	MB2	MB3	MB4	MB5	MB6	MB7	MB8	MB9
Session name	Decision Support Systems & Expert Systems	Probability & Statistical Modeling	Ergonomics/ Human Factors 1	Service Sciences 2	Quality Engineering & Managment 2	Production and Operations Management 2	Green Manufacturing/ Management	Transportation	Ergonomics & Welfare Management
Paper #	173	190	96	322	227	338	417	73	488
	254	299	131	401	228	362	550	91	484
	290	333	305	411	229	394	119	103	530
	460	334	315	479	346	396	156	312	485
	116	3354	326	504	294	442	342	340	471
	538	450	332	323	307		361	53	505
15:30-15:50	Coffee break								
15:50-17:50	Technical sessions MC								
	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8	MC9
Session name	Supply Chain Management 1	Reliability & Maintenance	Ergonomics/ Human Factors 2	Network Optimization	Quality Engineering & Management 3	Simulation 1	Healthcare Systems 1	Optimization Techniques 1	Educational Support System
Paper #	252	118	456	407	325	500	482	374	501
	261	121	359	363	328	196	99	217	562
	279	153	393	268	339	424	112	201	448
	280	320	419	515	346	66	194	169	455
	355	580	449	319	370	179	248	206	154
	336	582	341	142	402			271	507

Oct 14 (Tuesday)

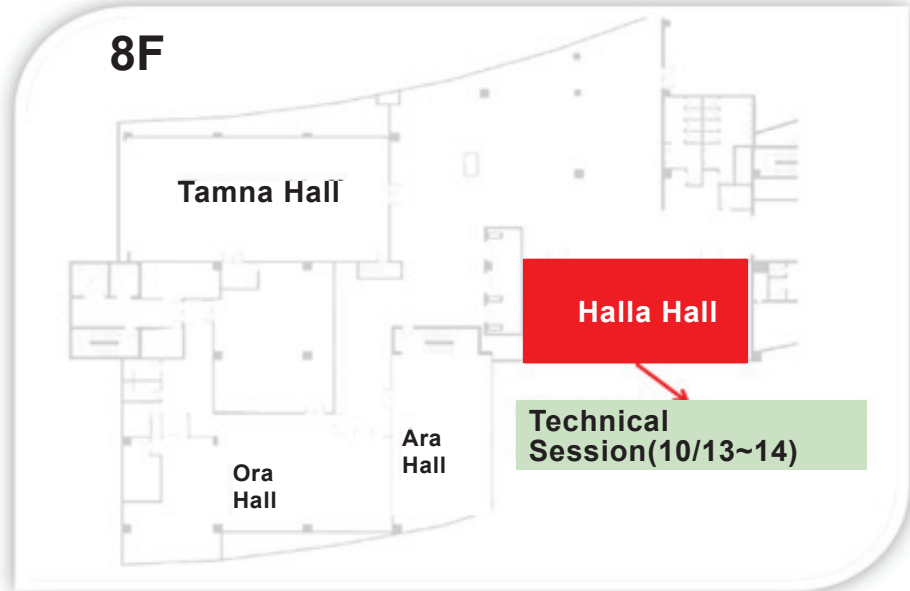
08:00-17:00	Registration								
Room	Mara	Biyang	Udo	Chuja	Ramada-1	Ramada-2	Ramada-3	Ramada-4	Halla(8F)
08:40-10:40	Technical sessions TA								
	TA1	TA2	TA3	TA4	TA5	TA6	TA7	TA8	TA9
Session name	Supply Chain Management 2	Communication Support	Data Mining 2	Tourism Management/ Topics in IE/MS	Sustainable Management	Simulation 2	Production & Operations Management 1	Logistics Management	Uncertainty Theory (Session II)
Paper #	50	443	128	472	35	98	282	440	558
	59	535	147	444	114	105	327	477	559
	60	489	203	564	136	221	349	483	560
	61	536	392	15	137	272	431	543	561
	130	480	412	264	291	295	104	344	565
	161	537	216	225	347	356	218	313	428
10:40-11:00	Coffee break								
11:00-12:00	Keynote speech II (Prof. Ronald Askin: Data Driven Decision Making in Manufacturing)								
12:00-13:00	Lunch								
13:00-14:00	Keynote speech III (Prof. Sungzoon Cho: Big Data Management)								
14:00-14:20	Coffee break								
14:20-16:00	Technical sessions TB								
	TB1	TB2	TB3	TB4	TB5	TB6	TB7	TB8	TB9
Session name	Supply Chain Management 3	Management of Technology and Innovations 2	Data Mining 3	Scheduling & Sequencing 1	Knowledge & Information Management	Production & Operations Management 2	Healthcare Systems 2	Flexible Manufacturing Systems	Topics in IE/MS
Paper #	165	188	437	122	250	49	95	579	575
	176	425	469	233	278	124	106	48	354
	208	317	486	284	445	151	306	62	378
	160	150	502	287	297	187	379	286	212
	234	22	581	309	389	12	76	457	202
16:00-16:20	Coffee break								
16:20-18:00	Technical sessions TC								
	TC1	TC2	TC3	TC4					TC9
Session name	Heuristics/Metaheuristics	Inventory Modeling / Artificial Intelligence	Artificial Intelligence	Scheduling & Sequencing 2					Lean Production Management
Paper #	70	381	182	399					542
	464	123	260	405					546
	481	101	490	418					94
	520	318	391	398					545
	192		499	79					547
13:00-18:00	POSTER Session								
Paper #	47	149	166	204	220	245	253	265	205
	365	366	382	400	414	422	432	435	524
	451	473	487	522	527	491	420	145	
18:30-21:00	General Reception								

## Oct 15 (Wednesday)

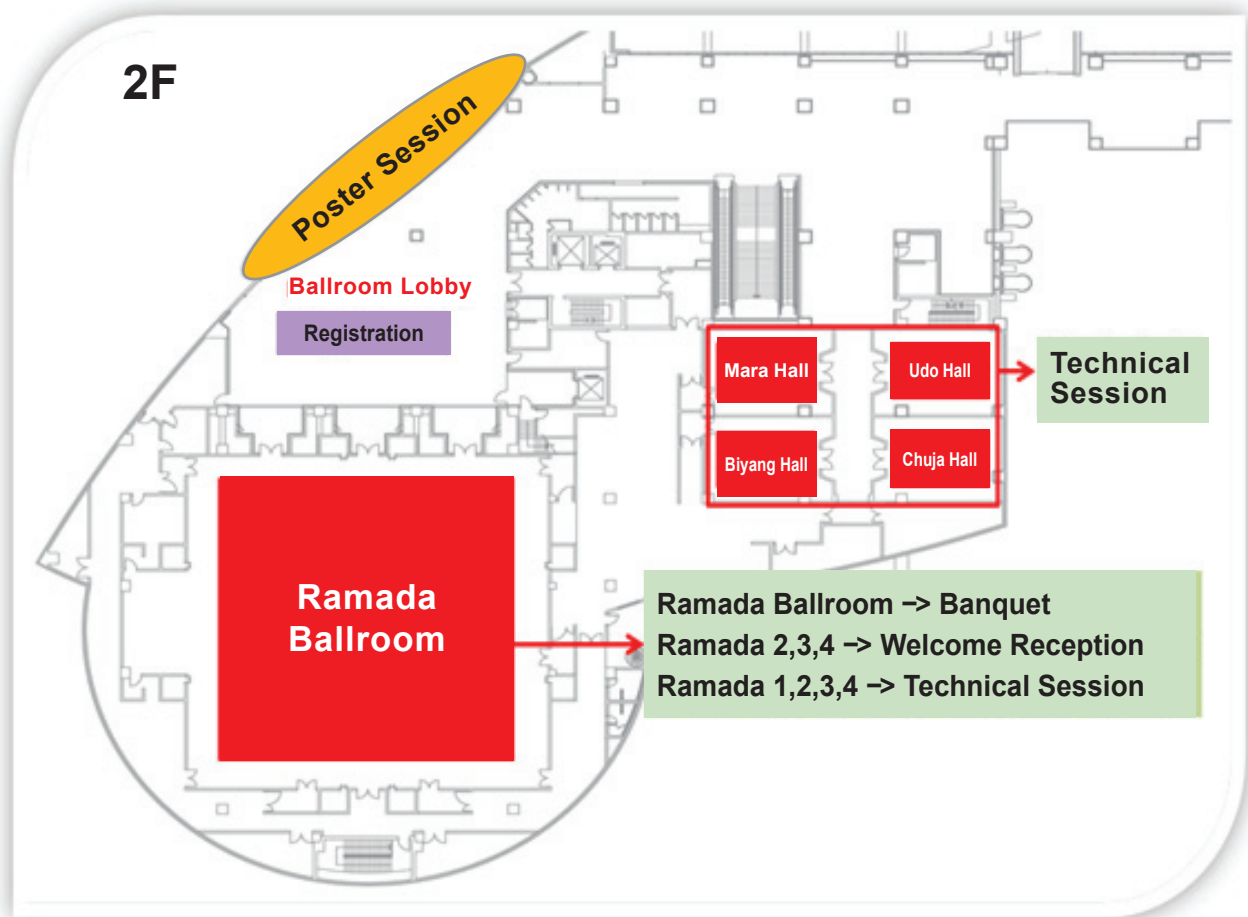
08:00-12:00	Registration							
Room	Mara	Biyang	Udo	Chuja	Ramada-3	Ramada-4	Ramada-1	Ramada-2
08:30-10:10	Technical sessions WA							
	WA1	WA2	WA3	WA4	WA5	WA6		
Session name	Inventory Mod- eling & Manage- ment	SCM and Forecasting 1	Production Design & Management 1	Scheduling & Sequencing 3	Fuzzy Logic	Optimization Techniques 2		
Paper #	65	92	117	85	30	125		
	80	31	162	120	58	69		
	71	34	198	177	224	288		
	446	32	222	316	576	577		
	518	102	249	509		415		
10:10-10:30	Coffee break							
10:30-12:10	Technical sessions TB							
	WB1	WB2	WB3	WB4	WB5	WB6		
Session name	Industrial Engineering Education	SCM and Fore- casting 2	Production Design & Management 2	Scheduling & Sequencing 4	Quality Engineering & Reliability	Lean Manufacturing		
Paper #	526	52	283	329	453	129		
	139	36	348	46	508	371		
	256	87	350	403	270	553		
	495	413	93	426	517	110		
			84	454	421	516		
12:10-13:30	Lunch							

# Floor Plan

8F



2F



# Detailed Program

## MA1 Data Mining 1

Mara, 08:30-10:10

**Chair:** Kuo-Hao Chang (National Tsing Hua University, Taiwan)

MA1-1 (528)	<a href="#">The Development Of An Educational Social Network To Support Blended-Learning In A University</a> <i>Vo DuyKhoi(International University, Viet Nam), *Do Truc(Vietnam National University HoChiMinh City, Viet Nam), Pham Quoc Son Lam, Le Thanh Son(International University, Viet Nam)</i>	1
MA1-2 (207)	<a href="#">A model for improving the customers' purchase willingness considering their latent intentions and media contacts.</a> <i>*Keisuke Korenaga, Satoshi Kumagai(Aoyama Gakuin University, Japan), Hiroki Nakano(NIFTY Corporation, Japan)</i>	7
MA1-3 (276)	<a href="#">The research of the onset factor of sports injuries in basketball</a> <i>*Takashi Matsumoto, Yukio Maruyama(Tokyo Metropolitan University, Japan), Hisashi Yamamoto(Nippon Institute of Technology, Japan)</i>	14
MA1-4 (324)	<a href="#">Multi-Objective Genetic Algorithm Using Fuzzy Membership Chromosome for Categorical Data</a> <i>*Chao-Lung Yang, Thi-Phuong-Quyen Nguyen, Ren-Jieh Kuo(National Taiwan University of Science and Technology, Taiwan)</i>	19
MA1-5 (296)	<a href="#">Using data mining methods to forecast book purchase quantities</a> <i>*Farnaz Pirasteh(Pukyong National Univesity, Korea), Mohammad Rouzbeh(Dayche Data Mining Group, Iran), Jay Liu(Pukyong National Univesity, Korea)</i>	25

## MA2 Management of Technology and Innovations 1

Biyang, 08:30-10:10

**Chair:** Muh-Cherng Wu (National Chiao Tung University, Taiwan)

MA2-1 (100)	<a href="#">Analyzing the effect of platform update period on platform diffusion in mobile ecosystem</a> <i>Gyesik Oh, *Yoo Hong(Seoul National University, Korea)</i>	29
MA2-2 (111)	<a href="#">Integrated Coal Gasification Technology Selection Model Considering Company's Research &amp; Development and Operational Decison Making</a> <i>*Iwan Wiratmadja(Bandung Institute of Technology, Indonesia), Muhammad Akbar, Anas Ma'ruf, Nanda Rusyda Saufa, Rajesri Govindaraju, Indryati Sunaryo(Faculty of Industrial Technology, Indonesia)</i>	35
MA2-3 (143)	<a href="#">ASSESSING TECHNOLOGY LEVEL OF INDUSTRIAL ESTATE TO MEET STANDARD OF ENVIRONMENT</a> <i>Dwi F.D. Nurcahya(Ministry of Industry, Indonesia), Muhammad Akbar(Bandung Institute of Technology, Indonesia), *dradjad irianto(bandung institute of technology, Indonesia)</i>	43
MA2-4 (44)	<a href="#">Economic Evaluation Method and Procedure for Improvement Activities</a> <i>*Hirokazu Kono(Keio University, Japan)</i>	50
MA2-5 (97)	<a href="#">A Market-Share-Driven Membership Pricing Strategy for Gyms</a> <i>*Muh-Cherng Wu, Wan-Ling Shen, Chung-Yu Chung(National Chiao Tung University, Taiwan)</i>	57

## MA3 ERP/E-Business

Udo, 08:30-10:10

**Chair:** Kazuhiko Yasuda (Tohoku University, Japan)

MA3-1 (37)	<a href="#">Review of the Concepts, Meanings, and Uses of Life Cycle</a> <i>*Kazuhiko Yasuda(Tohoku University, Japan), Tingting Huang(TOHOKU University, Japan)</i>	62
MA3-2 (38)	<a href="#">ERP Life Cycle Models: An Annotated Bibliographic Review</a> <i>*Kazuhiko Yasuda(Tohoku University, Japan), Tingting Huang(TOHOKU University, Japan)</i>	70
MA3-3 (352)	<a href="#">Analysis of Pricing and Promotional Strategies In The SAP ERP Simulation Game By Using A Model of A Dynamic System</a>	78



*\*yuli rochman(Universitas Islam Indonesia, Indonesia), erlangga fausa(Islamic University of Indonesia, Indonesia)*

MA3-4 (360)	<a href="#">Causal Analysis of Time Gap between Events in Multi-dimensional Process View</a> <i>Riska Sutrisnowati(Pusan National University, Korea), Sung-ook Sul(Total Soft Bank Ltd., Korea), *Hyelim Bae(Pusan National University, Korea)</i>	82
MA3-5 (255)	<a href="#">The Alignment Relationships between Electronic Business Strategy and Information Technology Capabilities</a> <i>*Yue-Yang Chen(I-Shou University, Taiwan), Szu-Yuan Sun, Chang-Yuan Chen(National Kaohsiung First University of Science and Technology, Taiwan)</i>	88

#### MA4 Service Sciences 1

Chuja, 08:30-10:10

**Chair:** Kwang-Jae Kim (POSTECH, Korea)

MA4-1 (54)	<a href="#">Service Quality Measurement Using Fuzzy Analytic Hierarchy Process: A Case Study</a> <i>*Chirakiat Saitthong, Dusadee Yaimana(Kasetsart University, Thailand)</i>	93
MA4-2 (55)	<a href="#">Quantifying the Relationships Among Service Quality, Customer Satisfaction, and Behavioural Intentions in Fast Food Restaurants Using Structural Equation Modelling</a> <i>*WILLY ZALATAR(DE LA SALLE UNIVERSITY, Philippines)</i>	100
MA4-3 (108)	<a href="#">Product-Service System Development Methods and Knowhow: A Review and Classification</a> <i>Chie-Hyeon Lim, *Kwang-Jae Kim(POSTECH, Korea)</i>	105
MA4-4 (215)	<a href="#">Designing a Service Process for Hypertension Patient Support</a> <i>Ryeok-Hwan Kwon, Chie-Hyeon Lim, Ki-Hun Kim, *Kwang-Jae Kim(POSTECH, Korea), Yaeun Kim, Sung-Hong Kang(Inje University, Korea)</i>	111
MA4-5 (244)	<a href="#">A Data-Driven Approach to Developing Service Concepts for Driving Safety Enhancement (a Case Study)</a> <i>Min-Jun Kim(POSTECH, Korea), Changho Lee(Quality System Laboratory, Korea), Chie-Hyeon Lim, *Kwang-Jae Kim, JINWOO JEON(POSTECH, Korea), Kyungim Choi, Yongsung Park(Korea Transportation Safety Authority, Korea)</i>	116

#### MA5 Quality Engineering & Management 1

Ramada-1, 08:30-10:10

**Chair:** Ruey Huei (Robert) Yeh (National Taiwan University of Science and Technology, Taiwan)

MA5-1 (23)	<a href="#">Application of a Design for Six Sigma (DFSS) Framework on a Proposed Launch of Operation of an Airline Exclusively for Pets</a> <i>*Marc Immanuel Isip(University of the Philippines Los Banos, Philippines)</i>	122
MA5-2 (28)	<a href="#">Traceability System for Quality Assurance on Make to Order Products</a> <i>*Iwan Vanany(Institut Teknologi Sepuluh Nopember Surabaya, Indonesia), Nur Aini Rahmawati(Institut Teknologi Sepuluh Nopember (ITS), Indonesia)</i>	130
MA5-3 (109)	<a href="#">Sequential Sampling Plan on Operating Characteristics Indexed by Quality Loss</a> <i>*Ryosuke Tomohiro, Ikuo Arizono(Okayama University, Japan), Yasuhiko Takemoto(Prefectural University of Hiroshima, Japan)</i>	137
MA5-4 (113)	<a href="#">Variable Repetitive Group Sampling Plan with Screening for Acceptance Quality Loss Limit Scheme</a> <i>*Yusuke Okada, Ryosuke Tomohiro, Ikuo Arizono(Okayama University, Japan)</i>	145
MA5-5 (226)	<a href="#">A Proposed Measures for Evaluation of Quality Excellence Practices in United Arab Emirates Industries</a> <i>*Mehran Doulat Abadi(Universiti Teknologi Malaysia (UTM), Malaysia), Sha'ri Mohd. Yusof(Universiti Teknologi Malaysia, Malaysia)</i>	153

#### MA6 Production and Operations Management 1

Ramada-2, 08:30-10:10

**Chair:** Daisuke Hirotani (Prefectural University of Hiroshima, Japan)

MA6-1 (75)	<a href="#">Hybrid Algorithm Based on an Integration of Genetic Algorithm and Recommended Heuristic Rules for Job Shop Scheduling Problem</a> <i>*Amer Boushaala, <u>Amer Boushaala</u>(Benghazi University, Benghazi, Libya, Libya)</i>	159
MA6-2 (158)	<a href="#">Efficient Machine Layout Design Method with a Fuzzy Set Theory within a Bay in a TFT-LCD plant</a> <i>*<u>Teng-Sheng Su</u>(National Taiwan University, Taiwan), Shih-Han Lin(National Chiao Tung University, Taiwan)</i>	168
MA6-3 (211)	<a href="#">Evaluating the Efficiency of International Hotels in Taiwan</a> <i>*<u>Ming-Chi Tsai</u>(College of Management, Taiwan), Khac Hung Dinh(College of Language Arts, Taiwan), Meei-Ing Tsai(I-Shou University, Taiwan)</i>	176
MA6-4 (269)	<a href="#">Worker Rearrangement Policy Using Worker's Position to Decrease Production Loss for Self-balancing Production Line with Worker's Learning</a> <i>*<u>Daisuke Hirotani</u>(Prefectural University of Hiroshima, Japan), Katsumi Morikawa, Katsuhiko Takahashi(Hiroshima University, Japan)</i>	183
MA6-5 (213)	<a href="#">To Evaluate the Operational Efficiency of Commercial Banks in Vietnam</a> <i>*<u>Ming-Chi Tsai</u>(College of Management, Taiwan), Duc Hieu Nguyen(I-Shou University, Taiwan), Meei-Ing Tsai(College of Management, Taiwan)</i>	190

## MA7 Metaheuristics

Ramada-3, 08:30-10:10

**Chair:** Ching-Jung Ting (Yuan Ze University, Taiwan)

MA7-1 (42)	<a href="#">A Particle Swarm Optimization Algorithm for Solving Economic Lot Scheduling Problems</a> <i>*<u>The Jin Ai</u>, Ririn Diar Astanti, Agustinus Gatot Bintoro(Universitas Atma Jaya Yogyakarta, Indonesia), Dah Chuan Gong(Chung Yuan Christian University, Taiwan)</i>	198
MA7-2 (43)	<a href="#">Application of Particle Swarm Optimization for the Capacitated Team Orienteering Problem</a> <i>Gustav Albertzeth, *<u>The Jin Ai</u>(Universitas Atma Jaya Yogyakarta, Indonesia)</i>	204
MA7-3 (175)	<a href="#">Variable Neighborhood Search for the Pollution Routing Problem</a> <i>*<u>Artiya Lathifah</u>, A.A.N Perwira Redi, Vincent Yu(National Taiwan University of Science and Technology, Taiwan), Nur Aini Masruroh(Gadjah Mada University, Indonesia)</i>	210
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Ramada-4, 08:30-10:10

**Chair:** Bong-Gyu Jang (POSTECH, Korea)

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MA8-4 (267)	<a href="#">Analysis of major crashes in Korean stock market</a> <i><u>Bong Gyun Ko</u>(seoul national university, Korea), *Jae Wook Song, Woojin Chang(Seoul National University, Korea)</i>	257
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**MA9 Uncertainty Theory (Session I)**

Halla(8F), 08:30-10:10

**Chair:** Jinwu Gao (Renmin University of China, China)

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Mara, 13:30-15:30

**Chair:** Hyerim Bae (Pusan National University, Korea)

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**MB2 Probability & Statistical Modeling**

Biyang, 13:30-15:30

**Chair:** Junghye Lee (POSTECH, Korea)

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**Chair:** Mao-Jiun Wang (National Tsing Hua University, Taiwan)

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**Chair:** Chen-Yang Cheng (Tunghai University, Taiwan)

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**MB5 Quality Engineering & Management 2**

Ramada-1, 13:30-15:30

**Chair:** Shu-Kai Fan (National Taipei University of Science and Technology, Taiwan)

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| MB5-3<br>(229) | <a href="#">An EWMA-based Sampling Plan for Lot Sentencing</a><br><i>Chou-Chun Wu, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>  | 440 |
| MB5-4<br>(246) | <a href="#">Developing a Two-Plan Sampling System Based on Process Loss Index</a><br><i>Ping-Jung Chiang, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>   | 445 |
| MB5-5<br>(294) | <a href="#">A similarity ranking approach to reduce false alarm of defect classification in CMOS Image Sensor Manufacturing</a><br><i>Chu-Yuan Fan, *Kuo-Hao Chang, Chen-Fu Chien, Ying-Jen Chen(National Tsing Hua University, Taiwan)</i>  | 449 |
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**MB6 Production and Operations Management 2**

Ramada-2, 13:30-15:30

**Chair:** Gyu M. Lee (Pusan National University, Korea)

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| MB6-2<br>(362) | <a href="#">A Study of Process Design for Manufacturing Line aimed at Levelization and Productivity on Mix Production</a><br><i>*Takumi Wada, Masahiro Arakawa(Nagoya Institute of Technology, Japan)</i>   | 467 |
| MB6-3<br>(394) | <a href="#">An Integrated Algorithm for Hybrid Flow Shop Scheduling Problem</a><br><i>*Shu-Fen Li, Chen-Yang Cheng, Zi-Hao Hong(Tunghai University, Taiwan)</i>   | 474 |
| MB6-4<br>(396) | <a href="#">Multi-Objective Genetic Algorithm for Energy-Efficient and Lot-Streaming Hybrid Flow Shop Scheduling</a><br><i>*TZU CHEN, Yi Chou(Fu Jen Catholic University, Taiwan), Yen Chen(Industrial Technology Research Institute, Taiwan)</i> | 481 |
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**MB7 Green Manufacturing/Management**

Ramada-3, 13:30-15:30

**Chair:** Hsiao-Fan Wang (National Tsing Hua University, Taiwan)

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| MB7-1<br>(417) | <a href="#">Equilibrium Contract Rents and Reward Money with Modularity Consideration in Reverse Supply Chains of Incomplete Information</a><br><i>*I-Hsuan Hong, Pei-Yun Ho(National Taiwan University, Taiwan)</i> | 496 |
| MB7-2<br>(550) | <a href="#">Demand response modeling for retailer considering operating ratio in electricity market</a><br><i>JINSIK KIM, *Chulung Lee(Korea University, Korea)</i>  | 504 |
| MB7-3<br>(119) | <a href="#">Batch Manufacture and Remanufacture for Periodic Demands</a><br><i>*Hsiao-Fan Wang, Chung-Yuan Fu(National Tsing Hua University, Taiwan)</i>   | 510 |
| MB7-4<br>(156) | <a href="#">Sustainability Product Design Assessment: Case Study of A Screw Design</a><br><i>Zahari Taha(Faculty of Manufacturing Engineering, Malaysia), *Hadi Abdul Salaam(Universiti</i>                          | 517 |

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*Ryota Aizawa*, \*Satoshi Kumagai(Aoyama Gakuin University, Japan), kishima shuuzou(Environmental Urban Systems Section, Japan)
- MB7-6  
(361) [Environmental Dynamics Analysis and Dynamic Capabilities Of Enterprises Competitiveness](#) 531  
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## MB8 Transportation

Ramada-4, 13:30-15:30

**Chair:** Jinho Lee (Korea Naval Academy, Korea)

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(91) [Break or Not?: Pioneering the Northern Sea Route with Presence of Icefloes](#) 548  
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- MB8-3  
(103) [Taxi Carpooling Problem Solved by Genetic Algorithm and Ant Colony Optimization Method](#) 553  
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(312) [Dairy transportation problem with no mixing of raw milk and time windows constraints](#) 561  
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- MB8-6  
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## MB9 Ergonomics & Welfare Management

Halla(8F), 13:30-15:30

**Chair:** Hiromi Ban ((Nagaoka University of Technology, Japan)

- MB9-1  
(488) [Development of the view measuring device for a visual field impaired person](#) 578  
\*Yuko Shimomura, Hiroyuki KAWABE(Kinjo University, Japan), Hidetaka Nambo(Kanazawa University, Japan), Syoji Yamada(Japan Advanced Institute of Science and Technology, Japan), Yasuaki Matumoto(Ecosysnetwork Co., Japan), Kazuaki Kojima(Ltd., Japan)
- MB9-2  
(484) [Development of eye tracking HMD system for visual field impaired students](#) 582  
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\*XINGYI JIN, Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)



**MC1 Supply Chain Management 1**

Mara, 15:50-17:50

**Chair:** Rainisa Heryanto (Maranatha Christian University, Indonesia)

MC1-1 (252)	<a href="#">A Multi-Criteria Selection for Inventory Aggregation Problem under Risk Pooling: A Case Study</a> <i>*<a href="#">Kanokporn Rienkhemaniyom</a>, Nipa Suttachai(King Mongkut's University of Technology Thonburi, Thailand)</i>	607
MC1-2 (261)	<a href="#">A Multi-Objective Closed-Loop Supply Chain Model For Multiple Generations of a Product with Mandatory Product Take-back</a> <i><a href="#">Justin Contreras</a>(De La Salle University - Manila, Philippines), *<a href="#">Dennis Cruz</a>(De La Salle University, Philippines)</i>	615
MC1-3 (279)	<a href="#">The Proposal of Applying Multi Echelon Inventory to Minimize Supply Chain Total Cost for Soft Drinks</a> <i>*<a href="#">Santoso</a> -, Rainisa Heryanto(Maranatha Christian University, Indonesia)</i>	623
MC1-4 (280)	<a href="#">The Improvement of the Model of Wheat Flour Requirement at Eastern Indonesia by Determining the Number Location of the New Plant</a> <i>*<a href="#">Rainisa Heryanto</a>(Maranatha Christian University, Indonesia), Senator Bahagia(Bandung Institute of Technology, Indonesia)</i>	630
MC1-5 (355)	<a href="#">Coordination of supply chains with risk-averse members under budget constraints</a> <i>*<a href="#">Ilkyeong Moon</a>, Xuehao Feng(Seoul National University, Korea)</i>	638
MC1-6 (336)	<a href="#">A MECE Feature Selection Framework for Yield Improvement in Semiconductor Manufacturing</a> <i>*<a href="#">CHIA-YEN LEE</a>, BO-SYUN CHEN(National Cheng Kung University, Taiwan)</i>	645

**MC2 Reliability & Maintenance**

Biyang, 15:50-17:50

**Chair:** Shinya Mizuno (Shizuoka University, Japan)

MC2-1 (118)	<a href="#">DELPHI-AHP BASED METHODOLOGY FOR SELECTING THE OPTIMUM MAINTENANCE STRATEGY FOR SHIP MACHINERY SYSTEMS</a> <i>*<a href="#">Ikuobase Emovon</a>, Rosemary Norman, Alan Murphy(Newcastle University, United Kingdom), Biliaminu Kareem(Federal University of Technology, Nigeria)</i>	653
MC2-2 (121)	<a href="#">Cost Minimization for Achieving a Target Operational Availability of a Warship through Sensitivity Analysis</a> <i><a href="#">Jinho Lee</a>, *<a href="#">Ki-Hoon Song</a>(Korea Naval Academy, Korea)</i>	661
MC2-3 (153)	<a href="#">Method of Minimizing Costs in Consideration of System Backup Intervals and Expected Costs</a> <i>*<a href="#">Shinya Mizuno</a>(Center for Information Infrastructure, Japan), Naoki Kondo(Shizuoka Professional Training College of Industrial Technology, Japan), Haruki Inoue, Takahiro Hasegawa, Naokazu Yamaki(Center for Information Infrastructure, Japan)</i>	667
MC2-4 (320)	<a href="#">Applied Algorithm for the Optimal Arrangement Problem of a Connected-(r, s)-out-of-(m, n):F System</a> <i>*<a href="#">Toru Omura</a>, Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)</i>	673
MC2-5 (580)	<a href="#">Interaction in Virtual Reality: A Review</a> <i>*<a href="#">Bereket Woldegiorgis</a>, Chiuhsiang Lin(National Taiwan University of Science and Technology, Taiwan)</i>	680
MC2-6 (582)	<a href="#">The implementation of the mobile-Computerized Procedure System Editor</a> <i><a href="#">Dae Seung Park</a>, *<a href="#">Yeonsub Jung</a>(Central Research Institute of Korea Hydro and Nuclear Power Co., Korea)</i>	688

**MC3 Ergonomics/Human Factors 2**

Udo, 15:50-17:50

**Chair:** Zahari Taha (Universiti Malaysia Pahang, Malaysia)



MC3-1 (456)	<a href="#">Ergonomic Assessment on Fatigue among Malaysian Express Bus Drivers Using the Partial Least Squares (PLS) Approach</a> <i>YUSOF HASHIM, *ZAHARI TAHA</i> (Universiti Malaysia Pahang, Malaysia)	692
MC3-2 (359)	<a href="#">Usability Point of View for Klasiber E-Learning in Islamic University of Indonesia</a> <i>*Muhammad Suryoputro</i> (Universitas Islam Indonesia, Indonesia), Amarria Sari(Islamic University of Indonesia, Indonesia), amalia rahmayani(islamic university of indonesia, Indonesia), Miftahulkhair Adianto(Islamic University of Indonesia, Indonesia)	702
MC3-3 (393)	<a href="#">The Relationships among Hand Size, Grip Span and Maximum Volitional Contraction and Hand-Grip Control Exerting</a> <i>*Kun Liao, Kun Liao</i> (Taiwan Shoufu University, Taiwan)	709
MC3-4 (419)	<a href="#">Evaluating the Appropriateness of Qualitative Research data using the measures in Semantic Network Analysis</a> <i>Ye Lim Rhie</i> (Seoul National University, Korea), *Ji Hyoun Lim, Min Ho Lee(Hongik University, Korea), Myung Hwan Yun(Seoul National University, Korea)	718
MC3-5 (449)	<a href="#">Analysis and Proposal about the Effect of Time, Types of Subject and Types of Room Factor to the Students' Concentration</a> <i>*Elty Sarvia, Evan Sentosa</i> (Maranatha Christian University, Indonesia)	724
MC3-6 (341)	<a href="#">Walking on the spot effects on sleep quality</a> <i>Ting Shao, *Dengchuan Cai</i> (National Yunlin University of Science and Technology, Taiwan)	731

#### MC4 Network Optimization

Chuja, 15:50-17:50

**Chair:** Hsiao-Fan Wang (Universiti Malaysia Pahang, Taiwan)

MC4-1 (407)	<a href="#">Paired Property Analysis for Optimal Worker Assignment -Worker Efficiency vs. Task -</a> <i>*Xianda Kong, Hisashi Yamamoto, Peiya Song</i> (Tokyo Metropolitan University, Japan), Jing Sun(Nagoya Institute of Technology, Japan), Masayuki Matsui(Kanagawa University, Japan)	739
MC4-2 (363)	<a href="#">Optimal Energy Supply-mix Model with Uncertain Monthly Capacity Factor of Renewable Energies</a> <i>Meng-Ping Sung, *Hsiao-Fan Wang</i> (National Tsing Hua University, Taiwan), Hsin-Wei Hsu(Industrial Technology Research Institute (ITRI), Taiwan)	745
MC4-3 (268)	<a href="#">Search Process for Pareto Solutions of a Two-objective Network by Combination of Network Properties</a> <i>*Natsumi Takahashi, Hisashi Yamamoto</i> (Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)	753
MC4-4 (515)	<a href="#">Acceleration Techniques of the Dynamic Programming Algorithms for Resource-Constrained Elementary Shortest Path Problem</a> <i>Hyunchul Tae, *Byung-In Kim</i> (POSTECH, Korea)	760
MC4-5 (319)	<a href="#">Solving the Multi-Modal Orienteering Problem with Time Windows using Paritcle Swarm Optimization</a> Vincent F. Yu, <i>*Parida Jewpanya, A.A.N. Perwira Redi</i> (National Taiwan University of Science and Technology, Taiwan)	768
MC4-6 (142)	<a href="#">Alternative-Fuel station location problem: efficiency and fairness</a> <i>Sungjae Park</i> (Sungkyunkwan University, Korea), Chang hyun Kwon(University at Buffalo, United States), <i>*Byung Do Chung</i> (Sungkyunkwan University, Korea)	776

#### MC5 Quality Engineering & Management 3

Ramada-1, 15:50-17:50

**Chair:** Chia-Yu Hsu (Yuan Ze University, Taiwan)

MC5-1 (325)	<a href="#">Developing a Variables Multiple Dependent State Sampling Plan with Loss-based Capability Index</a> <i>Zih-Huei Wang, *Chien-Wei Wu</i> (National Tsing Hua University, Taiwan)	783
MC5-2 (328)	<a href="#">Overall Automatic-optical-inspection efficiency (OAE) for Yield Enhancement in CMOS Image Sensor Manufacturing</a> <i>Ying-Jen Chen, Ci-An Rong, Kuo-Hao Chang, *Chen-Fu Chien</i> (National Tsing Hua University, Taiwan)	788

MC5-3 (339)	<a href="#">Variables Quick Switching Sampling System based on Process Performance Index</a> <i>Mei-Hsu Shih, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>	793
MC5-4 (346)	<a href="#">Applying Evolutionary Algorithm Approach for Optimizing Design of Chip Size</a> <i>*Chia-Yu Hsu, Shih-Chang Chiu(Yuan Ze University, Taiwan)</i>	799
MC5-5 (370)	<a href="#">Quality Design of Yarn Dyed Production Residu based on Taguchi and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method</a> <i>*Ali Parkhan, Faisal M, Djeni Hartika, Imam Widodo(Islamic University of Indonesia, Indonesia)</i>	804
MC5-6 (402)	<a href="#">Tool to Identify and Assess Human Values for TQM Implementation: A Proposal</a> <i>*muhammad malik(Universiti teknologi Malaysia, Malaysia), Sha'ri Mohd Yusof(Universiti Teknologi Malaysia, Malaysia)</i>	810

#### MC6 Simulation 1

Ramada-2, 15:50-17:50

Chair: Pudji Astuti (Trisakti University, Indonesia)

MC6-1 (500)	<a href="#">Development of an Artificial Housing Market Using Agent-Based Modeling</a> <i>Byeungchun Kwon, RI YU, KyeongTae Lee(Bank of Korea, Korea), *Nam-Wook Cho(Seoul National University of Science &amp; Technology, Korea)</i>	817
MC6-2 (196)	<a href="#">Design and development of a semiconductor wafer manufacturing simulation system</a> <i>*Li-Chih Wang(Tunghai University, Taiwan), Allen Wang(Department of Industrial Engineering and Enterprise Information Tunghai University, Taiwan), Chun-Ya Chueh(Tunghai University, Taiwan), Tai-Yen Tseng(Department of Industrial Engineering and Enterprise Information, Taiwan)</i>	823
MC6-3 (424)	<a href="#">CONCEPTUAL MODEL FOR SIMULATION OF COMMUTER LINE TRAFFIC AND OPTIMIZING HEADWAY</a> <i>*Pudji Astuti, Winnie Septiani, Sucipto Adisuwiryo, Liana Antoni(Trisakti University, Indonesia)</i>	829
MC6-4 (66)	<a href="#">Automatic defect inspection of TFT-LCD panels using Fourier image reconstruction</a> <i>*Du-Ming Tsai, Yan-Hsin Tseng(Yuan-Ze University, Taiwan), Wei-Yao Chiu(Industrial Technology Research Institute, Taiwan)</i>	834
MC6-5 (179)	<a href="#">Application of value stream mapping for lean management: a case study of air conditioner production line</a> <i>*Yi-Hsin Hu, James C. Chen(National Tsing Hua University, Taiwan), Tzu-Li Chen(Fu Jen Catholic University, Taiwan), Kirin Chen, Amy Hung(AXIS-group, Taiwan), Chun-Ju Lin(National Tsing Hua University, Taiwan)</i>	842

#### MC7 Healthcare Systems 1

Ramada-3, 15:50-17:50

Chair: Chie-Hyeon Lim (POSTECH, Korea)

MC7-1 (482)	<a href="#">Measuring Performance of Health Care Organizations using Integrated Balance Scorecard-AHP Technique</a> <i>*ira setyaningsih(Islamic State University UIN Sunan Kalijaga Yogyakarta, Indonesia)</i>	849
MC7-2 (99)	<a href="#">The Risk Assessment of Drug Safely for Emergency Patients Using Modified HFMEA</a> <i>*Chien-Chih Wang(Ming Chi University of Technology, Taiwan), Li-Jung Huang(Division Director, Taiwan), Hsin-Ning Pan, Yun-Ru Yang(Ming Chi University of Technology, Taiwan)</i>	856
MC7-3 (112)	<a href="#">A Multi-Perspective Approach to Service Quality Assessment in Private Hospitals</a> <i>*Joy Mari Bautista, Jazmin Tangsoc(De La Salle University, Philippines)</i>	859
MC7-4 (194)	<a href="#">A Personalized Tele-home Care System for Solitary Elders</a> <i>Jiun-Han Lin, *Hsiao-Fan Wang(National Tsing Hua University, Taiwan)</i>	866
MC7-5 (248)	<a href="#">A Robust Parameter Design Approach for Emergency Department Simulation</a> <i>*Chumpol Yuangyai, suriyaphong nilsang(King Mongkut's Institute of Technology Ladkrabang, Thailand), Kanokporn Rienkhemaniyom(King Mongkut's University of Technology Thonburi, Thailand), Udom Janjarassuk(King Mongkut's Institute of Technology Ladkrabang, Thailand)</i>	872

#### MC8 Optimization Techniques 1

Ramada-4, 15:50-17:50

**Chair:** Shi-Woei Lin (National Taiwan University of Science and Technology, Taiwan)

MC8-1 (374)	<a href="#">Evaluating the Economic Performance of ASEAN Countries by Data Envelopment Analysis</a> <i>Mohammad Jerusalem, *Shi-Woei Lin(National Taiwan University of Science and Technology, Taiwan)</i>	879
MC8-2 (217)	<a href="#">Detecting the Masked Efficient DMU in DEA</a> <i>Chiao-Pin Bao(I-Shou University, Taiwan), *Meei-Ing Tsai, Ming-Chi Tsai(College of Management, Taiwan)</i>	887
MC8-3 (201)	<a href="#">Process and Cost Optimization for Plastic Injection Molding by Data Envelope Analysis and Mathematical Programming</a> <i>Wu-Lin Chen(Providence University, Taiwan), Wan-Qiao Lai, Chen-Yu Huang, *Chin-Yin Huang(Tunghai University, Taiwan)</i>	894
MC8-4 (169)	<a href="#">Stochastic Global Optimization Using Sequential Kriging Metamodeling</a> <i>Yan-Han Lu, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>	901
MC8-5 (206)	<a href="#">Optimization of Air-Conditioning Energy Conservation by Mathematical Programming</a> <i>Wu-Lin Chen(Providence University, Taiwan), Chung-Wei Chou, Szu-han Chiu, *Chin-Yin Huang(Tunghai University, Taiwan)</i>	907
MC8-6 (271)	<a href="#">Expertise-based Experts Ranking at Multiplicative Preference Relations on Alternatives</a> <i>evy herowati, *evy herowati, evy herowati(University of Surabaya and Institute of Technology Sepuluh Nopember, Indonesia), Udisubakti Ciptomulyono(Institute of Technology Sepuluh Nopember, Indonesia), Joniarto Parung(University of Surabaya, Indonesia), Suparno Suparno(Institute of Technology Sepuluh Nopember, Indonesia)</i>	914

## MC9 Educational Support System

Halla(8F), 15:50-17:50

**Chair:** Masahide Yamamoto (Kanazawa Seiryu University, Japan)

MC9-1 (501)	<a href="#">A system of real time advice for speech improvement</a> <i>*Hiroshi Arai(Kinjo college, Japan), Hidetaka Nambo(Kanazawa University, Japan), Yuko Shimomura, Hirokyu KAWABE(Kinjo University, Japan), Shuichi Seto(Kinjo College, Japan)</i>	920
MC9-2 (562)	<a href="#">Consideration on English Learning for Undergraduates Using the Nintendo DS</a> <i>*Hiromi Ban(Nagaoka University of Technology, Japan), Haruhiko Kimura(Kanazawa University, Japan), Takashi Oyabu(Kokusai Business Gakuin College, Japan)</i>	924
MC9-3 (448)	<a href="#">The Analysis of Concept and Effect Factors on Financial Literacy</a> <i>*Yuji Kitano(Kanazawa Seiryu University, Japan), Koji Osanai(Shiga Junior college, Japan), Keiichi Nishio(Matsuyama University, Japan)</i>	929
MC9-4 (455)	<a href="#">The Present Conditions of the Computerization of Education and its Problems Concerning the Educator</a> <i>*Yumi Tatsushima(Kanazawa Seiryu University, Japan)</i>	936
MC9-5 (154)	<a href="#">AN ANALYSIS OF JOB SATISFACTION OF FACULTY MEMBERS OF BULACAN STATE UNIVERSITY MAIN CAMPUS (COLLEGE OF ENGINEERING)</a> <i>*Dyan Gonzales(Philippine Institute of Industrial Engineers, Philippines)</i>	941
MC9-6 (507)	<a href="#">Analysis the Influence of Study Program's Education Quality towards Graduates' Potential Marketing</a> <i>*Yulianti Talar, Jimmy Gozaly(Maranatha Christian University, Indonesia)</i>	948

## TA1 Supply Chain Management 2

Mara, 08:40-10:40

**Chair:** Etsuko Kusukawa (Osaka Prefecture University, Japan)

TA1-1 (50)	<a href="#">Impact of information sharing regarding customer returns ratio on optimal sales strategy under e-commerce</a> <i>*Yuta Saito, Etsuko Kusukawa(Osaka Prefecture University, Japan)</i>	957
TA1-2 (59)	<a href="#">Analyzing the evolutionary stability for behavior strategies in green supply chain</a> <i>*Daijiro Tomita, Etsuko Kusukawa(Osaka Prefecture University, Japan)</i>	965
TA1-3 (60)	<a href="#">Pareto-Based PSO Algorithm for Multi-Objective LRP</a> <i>*jie liu(student, Thailand), Voratas Kachitvichyanukul(professor, Thailand), jie liu(student, Thailand)</i>	973

TA1-4 (61)	<a href="#">Optimal Ordering Policy in Dual-Sourcing Supply Chain considering Supply Disruptions and Demand Information</a> <i>*Naoki Watanabe, Etsuko Kusakawa(Osaka Prefecture University, Japan)</i>	980
TA1-5 (130)	<a href="#">Research in Supply Chain Management: Issue and Area Development</a> <i>elisa kusrini(Department of Industrial Engineering, Indonesia), *siti Budijati(Faculty of Engineering, Indonesia), subagyo subagyo(Indonesian Islamic University, Indonesia), nuraini masrurroh(Yogyakarta, Indonesia)</i>	988
TA1-6 (161)	<a href="#">Cold Chain Logistics Development: Analyzing Taiwan Influences in Indonesia Market</a> <i>James C. Chen(National Tsing Hua University, Taiwan), Janet Chen, Yun-Wei Hung(Industrial Technology Research Institute, Taiwan), *Muhammad Rinaldi Darmawan, Nadia Aulia Arifin, Hsin-Yu Shih(National Tsing Hua University, Taiwan)</i>	996

## TA2 Communication Support

Biyang, 08:40-10:40

Chair: Sakiko Ogoshi (Kanazawa University, Japan)

TA2-1 (443)	<a href="#">Discrimination of Positive / Negative Attitude Using Optical Flow</a> <i>*Yuta Kobayashi(Kanazawa University, Japan), Munehiro Nakamura(Kanazawa Institute of Technology, Japan), Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)</i>	1003
TA2-2 (535)	<a href="#">Development of the support system for facial expression training</a> <i>*Yusuke Amagata, Yasuhiro Ogoshi(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(Chiba, Japan)</i>	1010
TA2-3 (489)	<a href="#">Discrimination of Micro-Expression with Subjective Assessments</a> <i>*Kiyotaka nakashima(Graduate School of Natural Science, Japan), Munehiro Nakamura(Kanazawa Institute of Technology, Japan), Haruhiko Kimura(Graduate School of Natural Science, Japan)</i>	1015
TA2-4 (536)	<a href="#">Facial electromyogram (FEMG) analysis of perception and rendering of facial expression</a> <i>*Akira Takahara, Yasuhiro Ogoshi(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(University of Fukui, Japan)</i>	1020
TA2-5 (480)	<a href="#">Text extraction in natural image</a> <i>*Masayoshi Ueno, Hidetaka Nambo, Haruhiko Kimura(Kanazawa University, Japan)</i>	1025
TA2-6 (537)	<a href="#">Electroencephalogram activity during imagined imitative learning</a> <i>*Shu Momose(University of Fukui, Japan), Sakiko Ogoshi(Kanazawa University, Japan), Yasuhiro Ogoshi(University of Fukui, Japan), Tomohiro Takezawa(The National Institute of Vocational Rehabilitation, Japan), Yoshinori Mitsuhashi(University of Fukui, Japan)</i>	1030

## TA3 Data Mining 2

Udo, 08:40-10:40

Chair: Jong-Seok Lee (Sungkyunkwan University, Korea)

TA3-1 (128)	<a href="#">AUC-based C4.5 tree induction for imbalanced data classification</a> <i>Jungmin Lee, Sungho Lee, *Jong-Seok Lee(Sungkyunkwan University, Korea)</i>	1035
TA3-2 (147)	<a href="#">Comparison of machine learning classifiers for glaucoma diagnosis using variable selection</a> <i>Su-Dong Lee, Jihyung Lee, Heecheon You, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1042
TA3-3 (203)	<a href="#">An iterative random sampling procedure for outlier detection</a> <i>Jihyun Ha, Seulgi Seok, *Jong-Seok Lee(Sungkyunkwan University, Korea)</i>	1049
TA3-4 (392)	<a href="#">Development of Knowledge Management for Forecasting in Restaurant Using Association Rule Mining and Regression Analysis</a> <i>*Annisa Khasanah, Agus Mansur, Yasser Ulil Albab(Universitas Islam Indonesia, Indonesia)</i>	1057
TA3-5 (412)	<a href="#">Data stream clustering by controlling decision errors</a> <i>Jeonghwa Lee, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1064
TA3-6 (216)	<a href="#">The moderating impact of employee's perceived self-efficacy on knowledge sharing intention</a> <i>*Mei-Fang Chen, Ssu-Wei Huang(Tatung University, Taiwan), Pei-Ju Tung(National Chengchi University, Taiwan)</i>	1071

**TA4 Tourism Management/ Topics in IE/MS**

Chuja, 08:40-10:40

**Chair:** Hidetaka Nambo (Kanazawa University, Japan)

- |                |   |      |
|----------------|---|------|
| TA4-1<br>(472) | <a href="#">Evaluation for painting show of kindergartner on rout bus in Kaga City</a><br><i>Eri Ishikawa, Ayano Kawasaki, Izumi Yamasaki(Kanazawa Seiryō University, Japan), *Takashi Oyabu(Kokusai Business Gakuin College, Japan)</i>  | 1077 |
| TA4-2<br>(444) | <a href="#">Utilization of historical materials and CGM for foreign visitors</a><br><i>*Ayako Sawada(Hokuriku Gakuin Junior College, Japan), Taketoshi Yoshida(Japan Advanced Institute of Science and Technology, Japan)</i>   | 1084 |
| TA4-3<br>(564) | <a href="#">The Verification of Mass Customization Systems in the Chinese Market</a><br><i>*Bin Fang(Kanazawa Seiryō University, Japan), Akinori Ono(Keio University, Japan)</i>  | 1090 |
| TA4-4<br>(15)  | <a href="#">Using SWOT Analysis to Evaluate the Public Procurement in Compliance with SNI (Case Study: Government Agency at Central of Java)</a><br><i>*Aries Susanty, Hery Suliantoro, Diana Puspitasari, Diena Novitasari, Nia Budi Puspitasari(Diponegoro University, Indonesia)</i> | 1094 |
| TA4-5<br>(264) | <a href="#">Designing Variables Quick Switching System with Process Loss Consideration</a><br><i>Yi-Jhen Jian, *Chien-Wei Wu(National Tsing Hua University, Taiwan)</i>   | 1100 |
| TA4-6<br>(225) | <a href="#">A Variables Multiple Dependent State Sampling Plan for Products with Unilateral Specification Limit</a><br><i>Chih-Chieh Chang Chien, *Chien-Wei Wu, Yi-Feng Hung(National Tsing Hua University, Taiwan)</i>  | 1105 |

**TA5 Sustainable Management**

Ramada-1, 08:40-10:40

**Chair:** Mei-Fang Chen (Tatung University, Taiwan)

- |                |  |      |
|----------------|--|------|
| TA5-1<br>(35)  | <a href="#">Sustainable supply chain management in competitiveness environment</a><br><i>Ming-Lang Tseng(Lunghwa University of Science and Technology, Taiwan), *Anthony Shun Fung Chiu(De La Salle University, Philippines), Ming Lim(Derby University, United Kingdom)</i> | 1110 |
| TA5-2<br>(114) | <a href="#">Sustainable management of Taiwan's semiconductor supply chain</a><br><i>*Chi-Tai Wang, Chui-Sheng Chiu(National Central University, Taiwan)</i>  | 1119 |
| TA5-3<br>(136) | <a href="#">The Use of Smart Meter Data to Analyze the Consumption Patterns</a><br><i>Chia-Yu Shen(National Tsing Hua University, Taiwan), *Hsiao-Fan Wang(Hsinchu, Taiwan)</i>  | 1124 |
| TA5-4<br>(137) | <a href="#">Time of Use Electricity Pricing Optimization in a Monopolized Electricity Market</a><br><i>Hsin-Yu Chiang, *Hsiao-Fan Wang(National Tsing Hua University, Taiwan)</i>  | 1131 |
| TA5-5<br>(291) | <a href="#">Modeling and Optimization of Power Storage Strategy of Hybrid Renewable Energy System in Uncertainty Environments</a><br><i>Chi-Kang Su, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>   | 1136 |
| TA5-6<br>(347) | <a href="#">What psychological factors influence the protection motivation of climate change?</a><br><i>*Mei-Fang Chen(Tatung University, Taiwan)</i>  | 1141 |

**TA6 Simulation 2**

Ramada-2, 08:40-10:40

**Chair:** Udom Janjarassuk (King Mongkut's Institute of Technology Ladkrabang, Thailand)

- |                |   |      |
|----------------|---|------|
| TA6-1<br>(98)  | <a href="#">Application of Agent-Based Modeling and Simulation for an Outpatient Department in a Hospital</a><br><i>*Chumpol Yuangyai(King Mongkut's Institute of Technology Ladkrabang, Thailand), Udom Janjarassuk(Faculty of Engineering, Thailand), Chonnupong Siritan(King Mongkut's Institute of Technology Ladkrabang, Thailand), Kanokporn Rienkhemaniyom(King Mongkut's University of Technology Thonburi, Thailand)</i> | 1147 |
| TA6-2<br>(105) | <a href="#">Integrated Maintenance and Inventory Optimisation Model for Offshore Assets</a><br><i>*Winda Cahyo(Islamic University of Indonesia, Indonesia)</i>  | 1154 |

TA6-3 (221)	<a href="#">A PSO-based Hybrid Approach for Buffer Allocation Problem with Uncertainty</a> <i>*James T. Lin, <u>Chun-Chih Chiu</u>(National Tsing-Hua University, Taiwan)</i>	1161
TA6-4 (272)	<a href="#">State-based Modeling and Simulation of Urban Traffic Systems Including Signalized Intersections</a> <i>*Mira Myong, Donghun Kang, Byoung Kyu Choi(KAIST, Korea)</i>	1167
TA6-5 (295)	<a href="#">MCMC algorithm using self-adaptive differential evolution and local optimization technique for Bayesian framework of complex systems</a> <i>Jun-Seong Kim, *Chi-Hyuck Jun(POSTECH, Korea)</i>	1174
TA6-6 (356)	<a href="#">Evaluation of the Behavior of Persons on a Floor in a Disaster Situation by Multi-Agent Simulation</a> <i>*Keita Sugiura, Masahiro Arakawa(Nagoya Institute of Technology, Japan)</i>	1179

## TA7 Production & Operations Management 1

Ramada-3, 08:40-10:40

**Chair:** Takayoshi Tamura (Aichi Institute of Technology, Japan)

TA7-1 (282)	<a href="#">Study and findings based on actual case data of the degree of the integration in regard to the production quality of information systems</a> <i>*Hideaki Hayashi, Etsuji Ohmura(Osaka University, Japan)</i>	1187
TA7-2 (327)	<a href="#">A Study on Standard Productivity for Comparing Productivity of an Assembly Line in Diversified Production Conditions</a> <i>*Kagehisa Nakayama(Waseda University, Japan), Shohei Machida, Hisashi Onari(WASEDA University, Japan)</i>	1195
TA7-3 (349)	<a href="#">Inventory Valuation Model Considering Profitability and Risk</a> <i>Kiho Kamiya, *Satoshi Kumagai(Aoyama Gakuin University, Japan), Ohba Masaaki(College of Economics, Japan)</i>	1201
TA7-4 (431)	<a href="#">A method of operational planning for project-based production in consideration of learning effects and demand uncertainty</a> <i>*YOSHIHIKO SUZUKI(Seiry Technica Co. Ltd, Japan), Nobuaki Ishii(Bunkyo University, Japan), masaaki muraki(Emeritus Professor, Japan)</i>	1208
TA7-5 (104)	<a href="#">Integrated Transport Terminal: Its Effect on Commuters' Travel Time, Cost, and Comfort (Or How Bitter-Sweet is the Metro Manila SWITT?)</a> <i>*RUMEL ATIENZA, <u>RUMEL ATIENZA</u>, Carlo Tansuk(DE LA SALLE UNIVERSITY, Philippines)</i>	1213
TA7-6 (218)	<a href="#">Effectiveness of an Exponential Smoothing System for a Multi-Stage Multi-Item Production System with Advance Demand Information</a> <i>*Takayoshi Tamura(Aichi Institute of Technology, Japan), Tej Dhakar(Southern New Hampshire University, United States)</i>	1219

## TA8 Logistics Management

Ramada-4, 08:40-10:40

**Chair:** Anchalee Supithak (Thai-Nichi Institute of Technology, Thailand)

TA8-1 (440)	<a href="#">Logistics Management of Oil Palm in Southern Region of Thailand</a> <i>*Phajongjit Pijitbanjong(Faculty of Industrial Technology, Thailand), Paroon Mayachearw(Songkhla Rajabhat University, Thailand), Rapeepan Pitakaso(Songkhla, Thailand)</i>	1227
TA8-2 (477)	<a href="#">On the resources required to provide persistent robotic service agents: Multiple immobile customers and a single service station</a> <i>Hyorin Park, *James Morrison(KAIST, Korea)</i>	1234
TA8-3 (483)	<a href="#">Solving Integrated Inventory and Open Vehicle Routing Problem in Two Depots and Multiple Retailers' Distribution System</a> <i>*Anchalee Supithak(Thai-Nichi Institute of Technology, Thailand)</i>	1242
TA8-4 (543)	<a href="#">Competitive Facility Location and Design Problem by Considering Conditions of Government Regulation and Regional Saturation</a> <i>Suprayogi Suprayogi, <u>Yosi Hidayat</u>(Institut Teknologi Bandung, Indonesia), *Utaminingsih Linarti(Ahmad Dahlan University, Indonesia)</i>	1250
TA8-5	<a href="#">Cooperative Tactical Planning in Road Transportation with Backhauling Management</a>	1256



(344)	<i>*Apichit Manee-ngam(Faculty of Engineering, Thailand), Apinanthana Udomsakdigool(King Mongkut's University of Technology Thonburi, Thailand)</i>	
TA8-6	<b>Monitoring Framework for Dynamic Inbound Flows</b>	1264
(313)	<i>Kiyoul Lee(POSTECH (Pohang University of Science &amp; Technology), Korea), Hyunbo Cho(POSTECH (Pohang University of Science &amp; Technology), Korea), *Mooyoung Jung(UNIST (Ulsan National Institute of Science &amp; Technology), Korea)</i>	

### TA9 Uncertainty Theory (Session II)

Halla(8F), 08:40-10:40

Chair: Xiaowei Chen (Nankai University, China)

TA9-1	<b>Towards Uncertain Network Optimization</b>	1270
(558)	<i>*Jin Peng(Huanggang Normal University, China)</i>	
TA9-2	<b>Viral Marketing of Multiple-Attribute Products in a Social Network</b>	1271
(559)	<i>Wei Li, *Yaodong Ni(University of International Business and Economics, China)</i>	
TA9-3	<b>Uncertain Logic Controller and Its Applications</b>	1279
(560)	<i>*Wei Dai(Central University of Finance and Economics, China)</i>	
TA9-4	<b>Uncertain Random Multilevel Programming</b>	1280
(561)	<i>*Hua Ke(Tongji University, China)</i>	
TA9-5	<b>Assets Pricing and Risk Management in Uncertain Market</b>	1281
(565)	<i>*Xiaowei Chen(School of Economics Nankai University, China)</i>	
TA9-6	<b>Liquidity Crashes and Robust Portfolio Management</b>	1282
(428)	<i>Seungkyu Lee(Pohang University of Science and Technology, Korea), *Bong-Gyu Jang, Seyoung Park(POSTECH, Korea)</i>	

### TB1 Supply Chain Management 3

Mara, 14:20-16:00

Chair: Muhammad Rusman (Hasanuddin University, Indonesia)

TB1-1	<b>Nash Equilibrium Retail Prices in a Planer Duopoly Market</b>	1295
(165)	<i>*Koichi Nakade, Akira Kanazawa(Nagoya Institute of Technology, Japan)</i>	
TB1-2	<b>A Proposal of Bargaining Solution for Cooperative Contract in a Supply Chain</b>	1303
(176)	<i>*Wakana Kato, Ikuo Arizono(Okayama University, Japan)</i>	
TB1-3	<b>Capacity Planning and Partnership Management</b>	1310
(208)	<i>*Cheng-Hung Wu, Wen-Lan Hsu(National Taiwan University, Taiwan)</i>	
TB1-4	<b>A multi-objective facility location problem in congested systems with service level for each facility and competitive environment</b>	1314
(160)	<i>*Mahsa Boroushaki(M.Sc. student of industrial engineering, Iran), hasan hosseini nasab(Associate professor, Iran)</i>	
TB1-5	<b>Blood Bank Location Model for Blood Distribution Planning in Makassar City</b>	1323
(234)	<i>*Muhammad Rusman(Hasanuddin University, Indonesia), Amrin Rapi(Ministry of Industry of Republic of Indonesia, Indonesia)</i>	

### TB2 Management of Technology and Innovations 2

Biyang, 14:20-16:00

Chair: Chih Wang (National Chiao Tung University, Taiwan)

TB2-1	<b>Establishment and development of the innovation-promoting organization for Industry</b>	1328
(188)	<i>*Kana Hayase, Nobutaka Odake(Nagoya Institute of Technology, Japan), Takeshi Matsumoto(Osaka Gas Co., Japan)</i>	
TB2-2	<b>Using Innovative Intellectual Property Indicators to Identify National Knowledge Flow Effects</b>	1336
(425)	<i>*Chin-Yuan Fan, Chia-Hao Hsu(Science &amp; Technology Policy Research and Information Center, Taiwan), shu-hao Chang(National Applied Research Labs, Taiwan), pin-hua Lin(Zhongli, Taiwan)</i>	



TB2-3 (317)	Development of Virtual Organisation Framework Model in Tourism Industry Using Axiomatic Design <i>*Agus Fauzi, Eny Maftuchah, Nasrullah Setiawan, Bambang Suratno(Universitas Islam Indonesia, Indonesia)</i>	1345
TB2-4 (150)	Supporting Technology Foresight for Disruptive Innovation: Keyword-based Visual Analysis for Futuristic Data <i>Jieun Kim, *Yongtae Park(Seoul National University, Korea)</i>	1352
TB2-5 (22)	Combining correspondence analysis with association rule mining to carry out market segmentation and product configuration <i>*Chih Wang(National Chiao Tung University, Taiwan)</i>	1358

### TB3 Data Mining 3

Udo, 14:20-16:00

Chair: Jen-Ying Shih (National Taiwan Normal University, Taiwan)

TB3-1 (437)	Comparative Benchmarking Analysis among Fine Jewelry and Costume Jewelry Companies in the Philippines Using Data Envelopment Analysis (DEA) <i>*Dennis Beng Hui, Emil Fernandez(De La Salle University Manila, Philippines)</i>	1366
TB3-2 (469)	A Prediction Method based on Weighted Ensemble of Decision Tree on Alternating Decision Forests. <i>*Shotaro Misawa, Naohiro Fujiwara(Graduate Student of Waseda University, Japan), Kenta Mikawa(Waseda University, Japan), Masayuki Goto Goto(Waseda University., Japan)</i>	1375
TB3-3 (486)	Creating Attractive Digital Signage Content at Universities <i>*RYO AKAIWA(Aoyama Gakuin University, Japan), RYUJI MAEKAWA, KAKURO AMASAKA(AOYAMA GAKUIN UNIVERSITY, Japan)</i>	1383
TB3-4 (502)	A Data Mining Approach for Loan Marketing Response Model <i>*Jen-Ying Shih(National Taiwan Normal University, Taiwan), Wun-Hwa Chen(National Taiwan University, Taiwan)</i>	1388
TB3-5 (581)	The 7-Eleven Rule in the Simulation Output Analysis <i>*Wheyming Song(professor, Taiwan)</i>	1394

### TB4 Scheduling & Sequencing 1

Chuja, 14:20-16:00

Chair: Byung Do Chung (Sungkyunkwan University, Korea, )

TB4-1 (122)	A two-stage assembly scheduling problem with makespan minimization <i>Lulu Hu, *Tsui-Ping Chung, Hongying Shan(Jilin University, China), Chien-Ming Chen(Harbin Institute of Technology Shenzhen Graduate School, China)</i>	1413
TB4-2 (233)	Particle swarm Optimization for minimizing electrical consumption for flexible flowshop problem <i>Krisanarach Nitisiri(Research Unit on Advanced Productivity Improvement and Logistics Management, Thailand), *Kanchana Sethanan(Faculty of engineering. Khon Kaen university, Thailand)</i>	1420
TB4-3 (284)	Campaign Planning for Multi-Purpose Batch Plants: A Case Study from the Pharmaceutical Industry <i>Mao-Kai Hsu, *Kuo-Hao Chang(National Tsing Hua University, Taiwan)</i>	1427
TB4-4 (287)	Multi-Jobs Lot Streaming to Minimize the Mean Maximum Completion Time in Multi-Stages Hybrid Flow Shop Scheduling <i>*Said Syahputra(Institut Teknologi Bandung, Indonesia, Indonesia), Anas Ma'ruf(Indonesia, Indonesia)</i>	1434
TB4-5 (309)	Shift-Scheduling Characteristic Identification of Non-Star Hotel Industry in Yogyakarta Indonesia <i>*Deny Yuniartha(Universitas Atma Jaya Yogyakarta, Indonesia), Ignatius Luddy Indra Purnama(Atma Jaya Yogyakarta University, Indonesia)</i>	1442

### TB5 Knowledge & Information Management

Ramada-1, 14:20-16:00

**Chair:** Minseok Song (Ulsan National Institute of Science and Technology, Korea)

- |                |   |      |
|----------------|---|------|
| TB5-1<br>(250) | <a href="#">Mergers and Acquisitions of ICT Firms for Technological Knowledge Sourcing</a><br><i><u>Yoonjung An</u>, *Yongtae Park</i> (Seoul National University, Korea)   | 1449 |
| TB5-2<br>(278) | <a href="#">Analyzing Service Processes Using Process Mining: A Case Study</a><br><i><u>Hanna Yang</u>, *Minseok Song</i> (Ulsan National Institute of Science and Technology, Korea)   | 1454 |
| TB5-3<br>(445) | <a href="#">Document Control for Research Reactor Construction by Advanced Nuclear Safety Information Management System</a><br><i>*Kook-Nam Park</i> (Korea Atomic Energy Research Institute, Korea), <i>Sung-Kyu Lee</i> (Divi-vision Co., Korea), <i>Seung-Mi Baek</i> (Korea Atomic Energy Research Instituti, Korea), <i>Min-Ho Choi</i> (Korea Atomic Energy Research Institute, Korea), <i>Yong-Se Kwon</i> (Korea Atomic Energy Research institute, Korea) | 1458 |
| TB5-4<br>(297) | <a href="#">Factors influencing user acceptance of intelligent personal assistants on smart devices</a><br><i>Jihye Park</i> (LG Household & Health Care, Korea), <i>Euiho Suh</i> (Pohang University of Science and Technology, Korea), <i>*Kiwon Lee</i> (Pohang University of Science and Technology (POSTECH), Korea)   | 1463 |
| TB5-5<br>(389) | <a href="#">Prognosis and Survival Prediction of Lung Cancer by Bayesian Network</a><br><i>*Shi-Woei Lin</i> , <i>Yu-Wei Chen</i> , <i>Mohammad Jerusalem</i> (National Taiwan University of Science and Technology, Taiwan)  | 1471 |

## TB6 Production & Operations Management 2

Ramada-2, 14:20-16:00

**Chair:** Ivy Mar Lamos (Bulacan State University, Philippines)

- |                |  |      |
|----------------|--|------|
| TB6-1<br>(49)  | <a href="#">Application of ECRS and Simulation Techniques in Bottleneck Identification and Improvement:A Paper Package Factory</a><br><i>*Chompoonoot Kasemset</i> , <i>Prin Pinmanee</i> , <i>Primapun Umarin</i> (Chiang Mai University, Thailand)   | 1477 |
| TB6-2<br>(124) | <a href="#">Assembly line type II problem of sewing lines in garment industry</a><br><i>James C. Chen</i> (National Tsing Hua University, Taiwan), <i>Tzu-Li Chen</i> (Fu Jen Catholic University, Taiwan), <i>Yi-Jhen Lin</i> , <i>*Chun-Ju Lin</i> , <i>Yi-Hsin Hu</i> (National Tsing Hua University, Taiwan) | 1485 |
| TB6-3<br>(151) | <a href="#">EFFICIENCY AND BETTER PRODUCTION FLOW FOR A MANUFACTURER OF STATUES: AN APPLICATION OF MOTION AND TIME STUDY</a><br><i>*Ivy Mar Ramos</i> , <i>Ivy Mar Ramos</i> (Bulacan State University, Philippines)   | 1492 |
| TB6-4<br>(187) | <a href="#">A Genetic Algorithm for Solving Assembly Line Balancing Problem in Footwear Stitching Line</a><br><i>James C. Chen</i> , <i>Tzu-Li Chen</i> , <i>*Chieh-Ying Lin</i> , <i>Chun-Ju Lin</i> (National Tsing Hua University, Taiwan)  | 1500 |
| TB6-5<br>(12)  | <a href="#">Pricing, Production, and Channel Coordination with Stochastic Learning</a><br><i>Tao Li</i> (Santa Clara University, United States), <i>*Suresh Sethi</i> (University of Texas At Dallas, United States), <i>Xiuli He</i> (University of North Carolina at Charlotte, United States)                 | 1507 |

## TB7 Healthcare Systems 2

Ramada-3, 14:20-16:00

**Chair:** Gino Lim (University of Houston, UnitedStates)

- |                |   |      |
|----------------|---|------|
| TB7-1<br>(95)  | <a href="#">Construct the Analysis Platform for Evaluating the Static Postural Stability</a><br><i>*Chih-Hung Jen</i> (Lunghwa University of Science and Technology, Taiwan), <i>Bernard C. Jiang</i> (National Taiwan University of Science and Technology, Taiwan), <i>Yin-Sung Chen</i> (Yuan Ze University, Taiwan) | 1512 |
| TB7-2<br>(106) | <a href="#">Recent Advances in Intensity Modulated Proton Therapy Treatment Planning Optimization</a><br><i>*Gino Lim</i> , <i>Wenhua Cao</i> (University of Houston, United States), <i>Radhe Mohan</i> (The University of Texas MD Anderson Cancer Center, United States)   | 1520 |
| TB7-3<br>(306) | <a href="#">Developing A Productivity Improving Framework by Overall Equipment Efficiency and An Empirical Study in A Hospital</a><br><i>*Chen-Fu Chien</i> , <i>Pei-Chun Chu</i> , <i>Mei-Li Kuo</i> (National Tsing Hua University, Taiwan)   | 1526 |
| TB7-4<br>(379) | <a href="#">An analysis of patients flow in a hospital case study using Simulation model and plant layout</a>   | 1534 |

- TB7-5 (76) [Willingness to pay for BPJS Health Insurance: Findings from an Exploratory Study](#) 1540  
*\*Aries Susanty*(Lecturer, Indonesia), *nia puspitasari*(diponegoro university, Indonesia), *Purnawan Wicaksono*(Lecturer, India), *Petty Primatury*(Student, Indonesia)

## TB8 Flexible Manufacturing Systems

Ramada-4, 14:20-16:00

**Chair:** Ibrahim Buseif (, Libya)

- TB8-1 (579) [The Comparison between Perpetual and Periodic-Review Models for Fast-Moving Products in Convenience Store Distribution Center](#) 1547  
*\*Yosi Hidayat*, *Veronica Adelein*, *Lucia Diawati*(Institut Teknologi Bandung, Indonesia)
- TB8-2 (48) [Using Petri Net \( PN \) Model for Design Flexible Manufacturing Systems \( Prototype FMS's \)](#) 1554  
*\*Ibrahim Buseif*(Staff member, Libya)
- TB8-3 (62) [New Model of FMS using FTPN with Demand Variability and Machine Breakdown](#) 1561  
*\*Muhammad Haris Aziz*(University of Engineering and Technology, Pakistan), *Erik L.J. Bohez*(Asian Institute of Technology, Thailand), *Abid Ali*, *Neelum Iqbal*(UET Taxila, Pakistan)
- TB8-4 (286) [Cellular Manufacturing System Model under Demand Uncertainty](#) 1567  
*\*Muhammad Shodiq Abdul Khannan*(Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia), *Anas Ma'ruf*(Indonesia, Indonesia), *Rachmawati Wangsaputra*(Institut Teknologi Bandung, Indonesia), *sutrisno sutrisno*(UPN Veteran Yogyakarta Indonesia, Indonesia)
- TB8-5 (457) [An iterative production planning approach for flexible semiconductor fabrication](#) 1575  
*\*Sun Hoon Kim*, *Young Hoon Lee*, *Cheng Yu Hwang*, *Kee Yong Shin*, *Ki Yol Nam*(Yonsei University, Korea)

## TB9 Topics in IE/MS

Halla(8F), 14:20-16:00

**Chair:** Taufiq Immawan (Islamic University of Indonesia, Indonesia)

- TB9-1 (575) [A study on relieving electric power shortage by on-site solar power supply](#) 1579  
*SangYun Choe*, *\*Jinwoo Park*(Seoul National Univ., Korea)
- TB9-2 (354) [Preliminary Study for Mapping of Business Process Re-engineering of Batik in Jogja and Solo](#) 1584  
*\*Taufiq Immawan*(Islamic University of Indonesia, Indonesia)
- TB9-3 (378) [Evaluation Method of Information Value Applying for Website](#) 1590  
*\*GaoYang Liang*(Graduate School of Business Administration Daito Bunka University, Japan), *Kiyoshi Nagata*(Informatics Faculty of Business Administration and Department of Business Studies Daito Bunka University, Japan)
- TB9-4 (212) [Lean Production in Automotive Parts Industry-A Case Study](#) 1598  
*James C. Chen*(National Tsing Hua University, Taiwan), *Tzu-Li Chen*(Fu Jen Catholic University, Taiwan), *Kirin Chen*, *Amy Hung*(AXIS-group, Taiwan), *\*Yu Liang*, *Chun-Ju Lin*(National Tsing Hua University, Taiwan)
- TB9-5 (202) [Optimum Humanitarian Relief Logistics for Facility and Stock Location under Time Restriction: Thai Flooding Case Study](#) 1604  
*\*WAPEE MANOPINIWES*, *KEISUKE NAGASAWA*, *TAKASHI IROHARA*(Sophia University, Japan)

## TC1 Heuristics/Metaheuristics

Mara, 16:20-18:00

**Chair:** Ma. Cecilia Buseif (Mapua Institute of Technology, Philippines)

- TC1-1 (70) [GA-BASED OPTIMAL FACILITY LAYOUT DESIGN: CROSSOVER AND MUTATION PROBABILITY EVALUATIONS](#) 1612  
*Maricar Misola*(Technological Institute of the Philippines- Quezon City, Philippines), *\*Ma. Cecilia Carlos*(Mapua Institute of Technology, Philippines), *Bryan Navarro*(Philippine Institute of Industrial Engineers (PIIE), Philippines)

TC1-2 (464)	<a href="#">An Improved Differential Evolution Algorithm for Vehicle Routing Problem: An Application in Mobile Medical Equipment Maintenance Unit</a> <i>*Kanokwan Supakdee</i> (Department of Industrial Management Technology, Thailand), Natthapong Nanthasamroeng(Faculty of Industrial Technology, Thailand), Rapeepan Pitakaso(Metaheuristics for Logistics Optimization Laboratory (MLO), Thailand)	1620
TC1-3 (481)	<a href="#">Heuristic for multi-stage capacitated p-median problem with supplier evaluation</a> <i>*Anurak Chaiwichian</i> , Rapeepan Pitakaso(Ubonratchathani University, Thailand)	1626
TC1-4 (520)	<a href="#">Heuristic Shift Scheduling for Airport Ground Staff</a> <i>*Kong Weng Lee</i> (UNIMAS, Malaysia), San Nah Sze(Faculty of Computer Science and Information Technology Universiti Malaysia Sarawak, Malaysia), Keat Keong Phang(Faculty of Computer Science and Information Technology Universiti Malaya, Malaysia)	1633
TC1-5 (192)	<a href="#">Optimization of Milk Productivity in Dairy Cattles by Genetic Algorithm</a> <i>*Senol Altan</i> (Gazi University, Turkey), <i>Fatih Akturk</i> (Ulsan National Institute Of Science and Technology, Korea), Emre Can Ozeler(Republic of Turkey Ministry of Food, Turkey)	1639

## TC2 Inventory Modeling / Artificial Intelligence

Biyang, 16:20-18:00

Chair: Wisut Supithak (Kasetsart University, Thailand)

TC2-1 (381)	<a href="#">Multi-Item Economic Production Quantity Model with the Consideration of Raw Material Inventory Management Costs</a> <i>*Wisut Supithak</i> (Kasetsart University, Thailand), Sasiprapa Limpakan(Kasetsart University, Thailand)	1647
TC2-2 (123)	<a href="#">A Stochastic Programming Model for Vendor Managed Inventory System of an Animal Feed Factory and Farm Network</a> <i>*Thawee Nakrachata-Amon</i> (Faculty of Engineering, Thailand), Supachai Pathumakul(Khon Kaen University, Thailand)	1654
TC2-3 (101)	<a href="#">Vendor Managed Inventory for Fresh Agricultural Products</a> <i>*Mitsuyoshi Horikawa</i> , Takeo Takeno, Mitsumasa Sugawara(Iwate Prefectural University, Japan)	1659
TC2-4 (318)	<a href="#">Vehicle risk assessment in accidents using neural network</a> <i>Yuri Castro</i> , *Young Jin Kim, Baek An Sun(Kyung Hee University, Korea)	1665

## TC3 Artificial Intelligence

Udo, 16:20-18:00

Chair: Ronaldo Polanco (De La Salle University, Philippines)

TC3-1 (182)	<a href="#">The Study of Tokai Cluster as a Leader of CFRP Industries in Japan</a> <i>*Akihito Zenke</i> , Nobutaka Otake(Nagoya Institute of Technology, Japan)	1672
TC3-2 (260)	<a href="#">Agent-based Real-time Scheduling for Smart Household Appliances</a> <i>Bobby Kurniawan</i> , *Anggoro Pramudyo, Didik Aribowo(Untirta, Indonesia), Anas Ma'ruf(Institut Teknologi Bandung, Indonesia)	1678
TC3-3 (391)	<a href="#">APPLICATION OF CLOUD-BASED KANBAN SYSTEM IN PROJECT MANAGEMENT</a> <i>Chi-Wei Shih</i> , *Chen-Yang Cheng(Tungshai University, Taiwan)	1683
TC3-4 (490)	<a href="#">User's Free Time Estimation When Using Smartphone</a> <i>*kohei Yamamoto</i> (Kanazawa Graduate School of Natural Science and Technology, Japan), Tatsuhito Hasegawa(Tokyo Health Care University, Japan), Haruhiko Kimura(Kanazawa University, Japan)	1688
TC3-5 (499)	<a href="#">Earned Value Management considering Milestone Weighting and Dependency Structure Matrix</a> <i>*Ronaldo Polanco</i> (De La Salle University, Philippines)	1692

## TC4 Scheduling & Sequencing 2

Chuja, 16:20-18:00

Chair: Hans-Otto Guenther (Seoul National University, Korea)

TC4-1 (399)	<a href="#">Improvement of Scheduling n Jobs m Machines Parallel Algorithm to Minimize Makespan</a> <i>*Rifa Arifati</i> (University of Pembangunan Nasional Veteran Jakarta, Indonesia), Aji P.	1696
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TC4-2 (405)	<a href="#">A Batch-scheduling problem to minimize actual flowtime of parts through the shop which has m heterogenous batch processors</a> <i>Nita Hidayat</i> (Industrial Engineering ITB, Indonesia), <i>Andi Cakravastia</i> , <i>TMA Ari Samadhi</i> (Bandung Institute of Technology, Indonesia), <i>*Abdul Halim</i> (Industrial Engineering ITB, Indonesia)	1701
TC4-3 (418)	<a href="#">Genetics Algorithm for Hybrid and Flexible Flowshop with Non-Identical Machines and Subcontract Case</a> <i>*Nora Azmi</i> (Trisakti University, Indonesia), <i>Gibtha Fitri Laksmi</i> (Ibnu Khaldun University, Indonesia)	1707
TC4-4 (398)	<a href="#">Mixed Integer Linear Programming for Un-related Parallel Machine Problems to Minimize Total Earliness and Tardiness - A Case Study of Precision Metal Tools Industry</a> <i>Chun Hsiung Lai</i> , <i>*Chen-Yang Cheng</i> (Tunghai University, Taiwan)	1714
TC4-5 (79)	<a href="#">A block planning model for integrated lot sizing and scheduling of continuous casters and hot strip mills in the steel industry</a> <i>*Hans-Otto Guenther</i> (Seoul National University, Korea), <i>Imke Mattik</i> (TU Berlin, Germany)	1719

#### TC9 Lean Production Management

Halla(8F), 16:20-18:00

**Chair:** Kenichi Nakashima (Kanagawa university, Japan)

TC9-1 (542)	<a href="#">Single-period inventory model considering a competitive store and two qualities of the product</a> <i>*Takashi Hasuike</i> (Osaka University, Japan)	1720
TC9-2 (546)	<a href="#">A Single-Producer Multi-Retailer Integrated Inventory System with Scrap in Production and Shortage in sale</a> <i>*Hitoshi Hohjo</i> , <i>Tomoki Koreeda</i> (Osaka Prefecture University, Japan)	1728
TC9-3 (94)	<a href="#">Joint replenishment problem with can-order policies under carrier capacity and correlated demands</a> <i>*KEISUKE NAGASAWA</i> , <i>Takashi Irohara</i> (Sophia University, Japan), <i>Yosuke Matoba</i> , <i>Shuling Liu</i> (Fairway Solutions Inc., Japan)	1733
TC9-4 (545)	<a href="#">Inventory-Production System with Non-Zero Target Inventory</a> <i>*Mohammadreza Parsanejad</i> (Keio University, Japan), <i>Bongsung Chu</i> (Soonchunhyang University, Japan), <i>Hiroaki Matsukawa</i> (Keio University, Japan)	1741
TC9-5 (547)	<a href="#">A Lean Supply Chain Control Problem with Stochastic Demand</a> <i>*Kenichi Nakashima</i> , <i>Thitima Sornmanapong</i> (Kanagawa University, Japan), <i>Hans Ehm</i> (Infineon Technologies AG, Japan), <i>Geraldine Yachi</i> (Infineon Technologies AG, Japan)	1746

#### WA1 Inventory Modeling & Management

Mara, 08:30-10:10

**Chair:** Nobuaki Ishii (Bunkyo University, Japan)

WA1-1 (65)	<a href="#">A Lot Size-Based Collaborative Demand-to-Supply Management System for Make-to-Order Environment</a> <i>*Nobuaki Ishii</i> (Bunkyo University, Japan), <i>Ko Sakashita</i> , <i>Tetsuo Yamada</i> (University of Electro-Communications, Japan), <i>Masaaki Ohba</i> (Nihon University, Japan), <i>Masayuki Matsui</i> (Kanagawa University, Japan)	1754
WA1-2 (80)	<a href="#">Reorder Point Determination Considering Customer Service Constraint under Limited Demand Information</a> <i>*Yasuhiko Takemoto</i> (Prefectural University of Hiroshima, Japan), <i>Ikuro Arizono</i> (Okayama University, Japan)	1762
WA1-3 (71)	<a href="#">Inventory Classification Involving Substitution Rules</a> <i>*Ikou kaku</i> , <i>Xinyi Zhang</i> (Tokyo City University, Japan)	1769
WA1-4 (446)	<a href="#">Reducing Inventory using Inventory Management Models</a> <i>*Sakgasem Ramingwong</i> , <i>Danuchin Anantana</i> (Center of Excellence in Logistics and Supply Chain Management, Thailand)	1775
WA1-5 (518)	<a href="#">An Approach for Avoiding Information Loss in Managing Product Safety Issue Associated with Suppliers</a> <i>Muhammad Saad Memon</i> , <i>*Young Hae Lee</i> , <i>Sonia Irshad Mari</i> (Hanyang University, Korea)	1779

**WA2 SCM and Forecasting 1**

Biyang, 08:30-10:10

**Chair:** Kazuhiro Takeyasu (Tokoha University, Japan)

- |                |  |      |
|----------------|--|------|
| WA2-1<br>(92)  | <a href="#">Forecasting utilizing a Day of the Week Index in the Case of Cafe</a><br><i>*Koumei Suzuki, Kazuhiro Takeyasu(Tokoha University, Japan)</i>  | 1787 |
| WA2-2<br>(31)  | <a href="#">Building BTO System in the Sanitary Materials Manufacturer Under the Improvement of Forecasting Accuracy</a><br><i>*Kazuhiro Takeyasu(Tokoha University, Japan), hirotake yamashita(Chubu University, Japan)</i>                               | 1795 |
| WA2-3<br>(34)  | <a href="#">UTILIZATION OF GENETIC ALGORITHM TO IMPROVE FORECASTING ACCURACY ? AN APPLICATION TO THE DATA OF A TUBE AND A CATHETER?</a><br><i>*Daisuke Takeyasu(The Open University of Japan, Japan), Kazuhiro Takeyasu(Tokoha University, Japan)</i>      | 1803 |
| WA2-4<br>(32)  | <a href="#">Optimal operation for green supply chain with quality of recyclable parts and contract for recycling activity</a><br><i>*Etsuko Kusukawa(Osaka Prefecture University, Japan), Sho Akizawa(Nara Institute of Science and Technology, Japan)</i> | 1811 |
| WA2-5<br>(102) | <a href="#">A Hybrid Method to Improve Forecasting Accuracy In the Case of Japanese Food Restaurant</a><br><i>*Jun Tatebayashi, Kazuhiro Takeyasu(Tokoha University, Japan)</i>  | 1819 |

**WA3 Production Design & Management 1**

Udo, 08:30-10:10

**Chair:** Philip Ermita (PIIE, Philippines)

- |                |  |      |
|----------------|--|------|
| WA3-1<br>(117) | <a href="#">Development a Latex Pillow to Meet Customer Requirements</a><br><i>*Nattapong KONGPRASERT(Facluty of Engineering, Thailand)</i>                            | 1827 |
| WA3-2<br>(162) | <a href="#">BananaNut Paper: REENGINEERING PAPER COMPONENT</a><br><i>*Marianne Calayag(Bulacan State University, Philippines)</i>                                      | 1834 |
| WA3-3<br>(198) | <a href="#">An Optimal Modularity for Platform-based Product Family Design of Wind Power Generators</a><br><i>*Qingnan Li(University of Southern Denmark, Denmark)</i> | 1838 |
| WA3-4<br>(222) | <a href="#">Composite Board Development: Use of Cardava Banana Peel and Watermelon Rind as Alternative Raw Materials</a><br><i>*Philip Ermita(PIIE, Philippines)</i>   | 1845 |
| WA3-5<br>(249) | <a href="#">Fairing of High Speed Milling tool-path by Using The Cubic NURBS</a><br><i>*Anh Duong, Anh Duong(International University in Vietnam, Viet Nam)</i>        | 1852 |

**WA4 Scheduling & Sequencing 3**

Chuja, 08:30-10:10

**Chair:** San-Nah Sze (Universiti Malaysia Sarawak, Malaysia)

- |                |  |      |
|----------------|--|------|
| WA4-1<br>(85)  | <a href="#">Scheduling with multi-attribute setup times on unrelated parallel machines</a><br><i>Ching-Jong Liao(National Taiwan University of Science and Technology, Taiwan), *Cheng-Hsiung Lee(Chihlee Institute of Technology, Taiwan), Hsing-Tzu Tsai, Kuo-Jui Wu(National Taiwan University of Science and Technology, Taiwan)</i> | 1859 |
| WA4-2<br>(120) | <a href="#">Scheduling on parallel machines with mold constraints</a><br><i>Haidan Zhao, *Tsui-Ping Chung, Hongying Shan(Jilin University, China), Chien-Ming Chen(Harbin Institute of Technology Shenzhen Graduate School, China)</i>   | 1867 |
| WA4-3<br>(177) | <a href="#">Transient Period Scheduling of Dual Armed Cluster Tools</a><br><i>*Nurhak Aktas, Taesun Yu, Tae-Eog Lee(KAIST, Korea)</i>  | 1874 |
| WA4-4<br>(316) | <a href="#">Adaptive Hybrid Genetic algorithm for solving two-stage reentrant flexible flow shop with blocking constraint</a><br><i>Chatnugrob Sangsawang, *Kanchana Sethanan(Research Unit on Advanced Productivity</i>   | 1880 |



- WA4-5  
(509) [Decision Support System for Order Online Delivery](#) 1888  
\*[San-Nah Sze](#), Bui-Fat Thian, Kang-Leng Chiew(Universiti Malaysia Sarawak, Malaysia)

#### WA5 Fuzzy Logic

Ramada-3, 08:30-10:10

**Chair:** Rionel Caldo (Lyceum of the Philippines University - Laguna, Philippines)

- WA5-1  
(30) [Predictive Approach of Assessing the Passing of Engineering Board Courses in Lyceum of the Philippines University-Laguna \(LPU-L\) Using Fuzzy Logic Technology](#) 1894  
\*[Rionel Caldo](#)(Lyceum of the Philippines University - Laguna, Philippines)
- WA5-2  
(58) [Fuzzy Logic Simulation of DC-DC Boost Converter Using Matlab Fuzzy Logic Toolbox](#) 1902  
[Rionel Caldo](#), \*[Rionel Caldo](#)(Lyceum of the Philippines University - Laguna, Philippines)
- WA5-3  
(224) [Cost Effectiveness Analysis Comparing Mastectomy versus Lumpectomy with Fuzzy Logic](#) 1908  
[Aysun Aktas](#), \*[gozde tutuncu](#)(Izmir University of Economics, Turkey)
- WA5-4  
(576) [Fuzzy AHP based Supplier Selection considering the Triple Bottom Line Concept](#) 1914  
[Wannimit Khampanya](#), [Tritos Laosirihongthong](#)(Thammasat University, Thailand), \*[Premaratne Samaranyake](#)(University of Western Sydney, Australia)

#### WA6 Optimization Techniques 2

Ramada-4, 08:30-10:10

**Chair:** Daniel Siek (Chung Yuan Christian University, Taiwan)

- WA6-1  
(125) [Impact of Globalization on Total Factor Productivity of the Manufacturing Sector in Pakistan](#) 1920  
\*[Usama Bin Perwez](#), [Muhammad Faseeh Tahir](#), [Aamir Ahmed Baqai](#)(National University of Sciences & Technology, Pakistan)
- WA6-2  
(69) [Optimal Solar Photovoltaic \(PV\) Penetration in Secondary Distribution Network Using Genetic Algorithm](#) 1929  
[Bryan Navarro](#)(Technological Institute of the Philippines, Philippines), \*[Maricar Misola](#)(Technological Institute of the Philippines- Quezon City, Philippines)
- WA6-3  
(288) [Numerical Analysis of Three Rookies Assignment Optimization in Limited-Cycled Model with Multiple Periods -the case of Erlang Distribution](#) 1937  
\*[Peiya Song](#), [Xianda Kong](#), [Hisashi Yamamoto](#)(Tokyo Metropolitan University, Japan), [Jing Sun](#)(Nagoya Institute of Technology, Japan), [Masayuki Matsui](#)(Kanagawa University, Japan)
- WA6-4  
(577) [Optimal Ordering Policies under a Progressive Interest Scheme with Supplier's Quantity Discount](#) 1945  
[Gary Chen](#), \*[Daniel Siek](#), [Hui Wee](#)(Chung Yuan Christian University, Taiwan)
- WA6-5  
(415) [An analysis on the influences of flat pricing for unlimited voice callings: the aspects of MNOs and consumers in Korea](#) 1951  
\*[SEONGJUN LEE](#), [SAESOL CHOI](#)(Electronics and Telecommunications Research Institute, Korea)

#### WB1 Industrial Engineering Education

Mara, 10:30-12:10

**Chair:** Young Jae Jang (KAIST, Korea)

- WB1-1  
(526) [Solution Based Learning: A New Approach in Product Design and Development Andragogy](#) 1957  
\*[Risdiyono Risdiyono](#)(Islamic University of Indonesia, Indonesia)
- WB1-2  
(139) [A study for making standardized-work tables suited for enterprises of the engineering / metalworking industry](#) 1962  
\*[Masahiro Shibuya](#)(Tokyo Metropolitan University, Japan), [Kenichi Iida](#)(Hokkaido Research Organization, Japan), [Koki Mikami](#)(Hokkaido University of Science, Japan)
- WB1-3  
(256) ["Implementation of methods and solutions for improving statistical thinking of non-English speaking students studying in Industrial Engineering field"](#) 1967  
\*[Huy Nguyen](#), [Huy Nguyen](#), [Huy Nguyen](#)(International University - Vietnam National University



WB1-4 (495)	<b>Industrial Engineering Education using KAIST LEGO Manufacturing Systems (KLMS)</b> <i>*Young Jang, Vina Yosephine(KAIST, Korea), Sun Kyung Oh(Korea Advanced Institute of Science and Technology, Korea), Sukhyun Cho, Kiryong Kyeong(KAIST, Korea)</i>	1975
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## WB2 SCM and Forecasting 2

Biyang, 10:30-12:10

**Chair:** Kazuhiro Takeyasu (Tokoha University, Japan)

WB2-1 (52)	<b>Improving Forecasting Accuracy in the Case of Intermittent Demand Forecasting</b> <i>Daisuke Takeyasu(The Open University of Japan, Japan), *Asami Shitara(Tax Corporation Arknet, Japan), Kazuhiro Takeyasu(Shizuoka City, Japan), Asami Shitara(Tax Corporation Arknet, Japan)</i>	1983
WB2-2 (36)	<b>Reformation of Production System Based Upon Demand Forecasting</b> <i>hirotake yamashita(Chubu University, Japan), *Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1991
WB2-3 (87)	<b>A Hybrid Method to Improve Forecasting Accuracy with An Application to the Data of Bread</b> <i>*Yuki Higuchi(Setsunan University, Japan), Hiromasa Takeyasu(Kagawa??? Junior??? College, Japan), Kazuhiro Takeyasu(Tokoha University, Japan)</i>	1999
WB2-4 (413)	<b>EXTENDED OPTIMAL REPLACEMENT POLICY FOR A TWO-UNIT SYSTEM UNDER CUMULATIVE DAMAGE MODEL</b> <i>*Shey-Huei Sheu, TZU-HSIN LIU(Providence University, Taiwan), ZHE-GEORGE ZHANG(Western Washington University, United States)</i>	2006

## WB3 Production Design & Management 2

Udo, 10:30-12:10

**Chair:** Masahiro Arakawa (Nagoya Institute of Technology, Japan)

WB3-1 (283)	<b>The Implementation of Affective Based Product Design in Small Enterprise Manufacturers</b> <i>*Imam Widodo, Tio Sampurno(Islamic University of Indonesia, Indonesia)</i>	2007
WB3-2 (348)	<b>A Study of Product Design Using Parts and Parts Structures Characterized by Reviews on Internet</b> <i>*Masahiro Arakawa, Eriko Katou(Nagoya Institute of Technology, Japan)</i>	2012
WB3-3 (350)	<b>Derivation of design freeze sequence using Bayesian network framework</b> <i>Jihwan Lee, *Yoo Hong(Seoul National University, Korea)</i>	2018
WB3-4 (93)	<b>Investigation of PLA/PCL biocomposite scaffolds fabricated via SVM rapid prototyping</b> <i>Kanokporn Kamonchit, *Thittikorn Phattanaphibul(Kasetsart University (Sriracha Campus), Thailand)</i>	2025
WB3-5 (84)	<b>Assessment of an ERP Graphical User Interface Design Related to Human Cognition</b> <i>*Grace Lorrain Intal, Catherine Briones(Mapua Institute of Technology, Philippines)</i>	2031

## WB4 Scheduling & Sequencing 4

Chuja, 10:30-12:10

**Chair:** Katsumi Morikawa (Hiroshima University, Japan)

WB4-1 (329)	<b>Simulation-based outpatient appointment scheduling with the aid of clearing function</b> <i>*Katsumi Morikawa, Katsuhiko Takahashi(Hiroshima University, Japan), Daisuke Hirotani(Prefectural University of Hiroshima, Japan)</i>	2040
WB4-2 (46)	<b>Flexible Jobshop Scheduling Model Considering Production Cost and Tardiness Cost Simultaneously</b> <i>*Devy Sari, Anas Ma'ruf(Institut Teknologi Bandung (Bandung Institute of Technology), Indonesia)</i>	2048
WB4-3 (403)	<b>Batch Scheduling for a Single Machine with Forgetting Effect to Minimize Total Actual Flow Time</b> <i>Rinto Yusriski, *Sukoyo -(Bandung Institute of Technology, Indonesia), T.M.Agung Samadhi(Institut Teknologi Bandung, Indonesia), Abdul Halim(Industrial Engineering ITB, Indonesia)</i>	2055
WB4-4 (426)	<b>Integrating Batch Production and Maintenance Scheduling on a Deteriorating Machine to Minimize Production and Maintenance Costs in Just in Time Environment</b>	2061

ZAHEDI \*(INSTITUT TEKNOLOGI BANDUNG, Indonesia), TMA Ari Samadhi, Suprayogi  
 .(Bandung Institute of Technology, Indonesia), \*Abdul Halim(Industrial Engineering ITB, Indonesia)

- WB4-5      **Creation of Total Shift Scheduling Model in Restaurant Service -An Example of the Highly**      2070  
 (454)      **Classical Luxury Hotel Restaurant -**  
               \*Kazuki Fujita, Kakuro Amasaka(Aoyama Gakuin University, Japan)

#### WB5 Quality Engineering & Reliability

Ramada-3, 10:30-12:10

**Chair:** Rionel Caldo (Lyceum of the Philippines University - Laguna, , Philippines)

- WB5-1      **Establishment of a New Vietnam Production Model**      2077  
 (453)      \*Shogo Miyashita, Kakuro Amasaka(Aoyama gakuin University, Japan)
- WB5-2      **A taxonomy of failure rate indexes based on literature review**      2083  
 (508)      sanghyeon koh(Pohang University of Science and Technology, Korea), kiwook jung, Bongjun Ji(Pohang university of science and technology, Korea), \*Hyunbo Cho(POSTECH, Korea)
- WB5-3      **Comparative Study of SA algorithms of optimal arrangement problem in a Multi-state k-out-**      2090  
 (270)      **of-n:F system**  
               \*Naoki Yoshida(Tokyo Metropolitan University, Japan), Koji Shingyochi(Jumonji University, Japan), Hisashi Yamamoto(Tokyo Metropolitan University, Japan), Tomoaki Akiba(Chiba Institute of Technology, Japan), Xiao Xiao(Tokyo Metropolitan University, Japan)
- WB5-4      **A New Universal Generating Function Method to Search for all Minimal Paths Generate in**      2098  
 (517)      **Networks**  
               Wei-Chang Yeh(National Tsing Hua University, Taiwan), \*Hui-Wen Lee(National Tsing Hua University Hsinchu, Taiwan)
- WB5-5      **Prioritizing the Factors for Quality Excellence Practices Using Analytic Hierarchy Process**      2106  
 (421)      **(AHP) Method**  
               \*Mehran Doulat Abadi(Universiti Teknologi Malaysia (UTM), Malaysia), Sha'ri Mohd. Yusof(Universiti Teknologi Malaysia, Malaysia)

#### WB6 Lean Manufacturing

Ramada-4, 10:30-12:10

**Chair:** Daniel Siek (Chung Yuan Christian University , Taiwan)

- WB6-1      **LINEASSEMBLY ANALYSIS FOR PC-250 PRODUCT TYPE WITH HEURISTIC METHOD**      2107  
 (129)      **AT PT. TIRTA INTIMIZU NUSANTARA**  
               \*Lina Gozali(Tarumanagara University, Indonesia), Silvi Ariyanti(University of Mercu Buana, Indonesia), Rendy .(University of Tarumanagara, Indonesia)
- WB6-2      **Waste Reduction in Work Processes Using Lean Tools and Simulation: A Case Study**      2113  
 (371)      **Logistics Service Providers**  
               Worakit Changjuttaras(Department of Industrial Engineering Faculty of Engineering of Khon Kaen University, Thailand), \*Panitarn Peerapattana(Department of Industrial Engineering Faculty of Engineering of Khon Kean University, Thailand)
- WB6-3      **A Framework to Apply Cellular Manufacturing**      2119  
 (553)      \*Wei Weng, Atsushi Fukui, Shigeru Fujimura(Waseda University, Japan)
- WB6-4      **A Study on the E-Waste Generation and Management in the Philippines: It's Impact and**      2126  
 (110)      **Significance**  
               \*Nestor Ong(University of Santo Tomas, Philippines), Patricia Kamil Kinol, Angela Camille San Miguel, Charlene Mae Ramirez(Faculty of Engineering, University of Santo Tomas, Philippines)
- WB6-5      **A model for Designing Resilient and Sustainable Supply Chain under Disruptions**      2134  
 (516)      **Sonia Irshad Mari**, \*Young Hae Lee, Muhammad Saad Memon(Hanyang University, Korea)

#### POSTER Poster Session

Halla(8F), 13:00-18:00

**Chair:** (, )

- POSTER-1      **Measuring organizational performance by integrating competitive intelligence into decision**      2142  
 (47)      **support system**

POSTER-2 (149)	<a href="#">Expediting Rate of Production of Flip Flops through Methods Engineering</a> <i>*Dyan Gonzales(Philippine Institute of Industrial Engineers, Philippines)</i>	2148
POSTER-3 (166)	<a href="#">A Framework for Intelligent Condition Monitoring System using Knowledge Discovery in Databases</a> <i>Sedo Oh, *Young-jin Kim(Kyung Hee University, Korea)</i>	2156
POSTER-4 (204)	<a href="#">Ergonomically Designed Armchair for Both Left- and Right-Handed Students</a> <i>*Juan Tecson(Bulacan State University, Philippines)</i>	2159
POSTER-5 (220)	<a href="#">Scheduling outpatient appointments in a neurosurgery department of a university hospital</a> <i>Youngmin Ki, *Byung-In Kim(POSTECH, Korea), Byung Kwan Choi(School of Medicine Pusan National University, Korea), Sung-Hong Kang(Inje University, Korea)</i>	2165
POSTER-6 (245)	<a href="#">An intelligent parking guidance methodology</a> <i>*Jong-Ho Shin(UNIST, Korea), Hong-Bae Jun, Sang-Je Cho(Hongik University, Korea)</i>	2169
POSTER-7 (253)	<a href="#">Effect of number of operations of touch panel on whole body working posture and physical workload</a> <i>*Makoto Kadamatsu, Akihiko Seo(Tokyo Metropolitan University, Japan)</i>	2175
POSTER-8 (265)	<a href="#">Development of Factory Layout Design Method by Distribution Time-space Mesh Analysis</a> <i>*Munenori Kakehi(Tokyo University of Science, Japan), Ichie Watanabe(Seikei University, Japan), Masahiro Nakamura(LEXER RESEARCH Inc., Japan)</i>	2179
POSTER-9 (365)	<a href="#">A New approach in Fault Recognition using Mel Cepstrum Coefficients and Hidden Markov Models</a> <i>*Young Kim, Monica Chamay Castro(Kyung Hee University, Korea)</i>	2183
POSTER-10 (366)	<a href="#">Differences in the perception of determining factors in inter-organizational relationships</a> <i>*Su-Jin Youn(ETRI (Electronics and Telecommunications Research Institute), Korea), Yanghon Chung(KAIST((Korea Advanced Institute of Science and Technology), Korea)</i>	2188
POSTER-11 (382)	<a href="#">Do Young People Trust e-Government As Much As Their Internet Experiences? A Preliminary Study in Bandung City</a> <i>*Dea Marella(Bandung Institute of Technology, Indonesia), Nadinastiti Muladi(Institut Teknologi Bandung, Indonesia), Pravitasari -(Universitas Indonesia, Indonesia)</i>	2193
POSTER-12 (400)	<a href="#">Statistical Forecasting of Material Demand through Big Data Analysis</a> <i>JeongAh Yoon, MinJeong Park(UNIST, Korea), Hanna Yang(Ulsan National Institute of Science and Technology, Korea), *Daeil Kwon(UNIST, Korea), Minseok Song(Ulsan National Institute of Science and Technology, Korea)</i>	2198
POSTER-13 (414)	<a href="#">Prediction for Material Usage Using Decision Tree</a> <i>Minjeong Park, *Minseok Song, Daeil Kwon(Ulsan National Institute of Science and Technology, Korea)</i>	2201
POSTER-14 (422)	<a href="#">Design and Development of an Automated Blood Typing Device</a> <i>Jhunlyn Lorenzo, *Jhunlyn Lorenzo(Cavite State University, Philippines)</i>	2204
POSTER-15 (432)	<a href="#">Activate a depopulated district using POS data analysis</a> <i>Akira Matsuura, *Kohsuke Katoh(Kanazawa Institute of Technology, Japan)</i>	2212
POSTER-16 (435)	<a href="#">An improved quantum-behaved particle swarm optimization based multilayer perceptron classifier for medical data classification</a> <i>*Jui-Yu Wu(Lunghwa University of Science and Technology, Taiwan)</i>	2219
POSTER-17 (451)	<a href="#">Evaluating Credit Ratings Prediction by Using the Distance to Default and Data-mining techniques</a> <i>*Hsu-Che Wu, Wu Yu-Ting(National Chung Cheng University, Taiwan)</i>	2225
POSTER-18 (473)	<a href="#">Complex Network Analysis of the Korean Transportation Network</a> <i>*Woo-Sung Jung(POSTECH, Korea)</i>	2231
POSTER-19 (487)	<a href="#">A System for Extraction and Analysis of Emerging Technology</a> <i>Dong-Suk Hong(Korea Federation of Banks, Korea), *Han-Gook Kim(Korea Institute of Science and Technology Information, Korea)</i>	2235
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POSTER-21 (527)	<a href="#">Can the ease of information retrieval change aesthetics judgments principle?</a> <i>*Wei-hao Yang, <u>Yu-Shan Chen</u>, Lien-ti Bei(National Chengchi University, Taiwan)</i>	2242
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# Application of Particle Swarm Optimization for the Capacitated Team Orienteering Problem

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**Abstract.** The capacitated team orienteering problem (CTOP) is one of important transportation problem that can be faced by any organization. In this problem, there are several location or being called vertex. Each vertex has specific score, which will be collected if the vertex is visited by any transportation vehicle. The transportation time between two vertices are defined. There are time and capacity constraints of transportation vehicles, indicates by  $T$  and  $Q$ , respectively. The CTOP objective is to find the path of several transportation vehicles visiting some selected vertices in order to maximize total collected score within the constraint of  $T$  and  $Q$ . Various algorithms, such as branch and price, variable neighborhood search, and bi-level filter and fan, have been proposed for solving the CTOP. While the particle swarm optimization (PSO) has been applied to solve similar problems of CTOP such as team orienteering problem (TOP) and team orienteering problem with time windows (TOPTW). This paper tries to apply the PSO for solving the CTOP. The computational results show that the proposed PSO algorithm is able to obtain 47 best known solutions of 130 benchmark problems.

**Keywords:** Capacitated Team Orienteering Problem, Particle Swarm Optimization, Solution Representation, Computational Method, Metaheuristics

## 1. INTRODUCTION

The capacitated team orienteering problem (CTOP) is a problem for determining several paths of transportation vehicle in order to maximize total collected profit by visiting some customer through the paths with some restrictions. As defined in earlier research, i.e. Archetti et al. (2009), the CTOP can be formally defined as follow. Let us consider a set of visiting points  $V = \{1, 2, \dots, n\}$  represent potential customers, plus a depot indexed by 0. Let  $G=(V,E)$  be an undirected graph where  $G$  is the set of vertices and  $E$  is the set of edge.  $m$  identical vehicles of capacity  $Q$  are stationed at the depot. A non-negative demand  $d_i$  and a non-negative profit  $p_i$  is associated with each customer  $i$ , whereas  $p_0 = d_0 = 0$ . A symmetric travel time  $t_{ij}$  is associated with each edge  $(i, j) \in E$ . Each vehicle starts and ends its tour at the depot (vertex 0), and can visit any subset of customers with a total demand that does not exceed the capacity  $Q$ . The profit of each customer can be collected by one vehicle at most. A subset of the potential customers available has to be selected, in order to maximize the total collected profit while satisfying, for

each vehicle, a time limit  $T$  on the tour duration and the capacity constraint  $Q$ .

This problem is one of important transportation problem that can be faced by any organization besides the orienteering problem (OP), team orienteering problem (TOP), traveling salesman problem (TSP), and vehicle routing problem (VRP). All of these problems are concerned with the transportation of vehicle(s) to visit some customers. Regarding to the customers to be visited, the TSP and VRP are required all customers to be visited, while the OP, TOP, and CTOP are not need this requirement. Regarding to the number of vehicles, the OP and TSP are problems with single vehicle, while the TOP, CTOP, and VRP are problems with more than one vehicles. Regarding to the capacity of vehicle(s), the OP, TSP, and TOP are not including vehicle capacity as constraint, while the CTOP and VRP include vehicles capacity as their constraints. More detail reviews on these problems can be found in Guttin and Punnen (2002), Golden et al. (2008), and Vansteenwegen et al. (2011).

Similar with TOP, the CTOP is also an NP-hard problem, hence some exact and heuristics approaches had

been proposed in the past for solving the CTOP. For solving the CTOP, Archetti et al. (2009) proposed an exact method, which is branch-and-price method, and three metaheuristics, which are variable neighborhood search, and two variations of tabu search: tabu feasible and tabu admissible. Tarantilis et al. (2013) proposed a heuristics called bi-level filter and fan method for solving the CTOP. They proposed slow and fast version of the method, based on the number of iterations used in the method.

Since PSO has been successfully applied for solving other problems that are related to CTOP, such as VRP (Ai and Kachitvichyanukul, 2009; Kuo et al., 2012; Tlili et al., 2013) and TOP (Dang et al., 2013; Ai et al., 2013), therefore, this paper tries to solve the CTOP by using a PSO algorithm. The rest of this paper is organized as follows: Section 2 describes the PSO for solving the CTOP. Section 3 presents the computational result, and the last section concludes the paper and gives suggestions for further research.

## 2. PROPOSED PSO ALGORITHM

Kennedy and Eberhart (1995) proposed the Particle Swarm Optimization (PSO), which is a population-based stochastic optimization technique, by mimicking the physical movement of individuals in the swarm as searching mechanism of optimal solution. In the PSO, the capability of solution searching is included in the properties of a group of particles, which are called position and velocity. A multi-dimensional-space particle position represents an alternative of problem solution. Velocity of particle is the driver of particle movement from one position to another. By moving to other position, another alternative of problem solution is evaluated.

For driving the movement of particles, PSO also imitates two important behaviors of the swarm organism, which are the cognitive behavior and the social behavior. The cognitive behavior is defined as the tendency of particle moving towards the best position ever visited by the particle, which is usually called personal best or pbest. While the social behavior is defined as the tendency of particle moving towards the best position ever visited by all particles in the swarm, which is usually called global best or gbest. The movement of particle in certain period of time is driven by three different directions that are: 1) follow its own way, 2) go towards its personal best position, and 3) go towards its global best position.

In general, the algorithm of PSO can be formally defined as follow:

1. initialization of particles, their position and initial velocity,
2. decode particles into problem solutions,

3. evaluate the quality of particles, based on their corresponding objective functions,
4. update pbest value,
5. update gbest value,
6. update velocity and position for each particle,
7. if the stopping criterion, i.e. maximum number of iteration, is reached, stop. Otherwise return to step 2.

Following this algorithm, the best problem solution is represented by the global best at the end of iteration. The details of PSO can be found in several textbooks, among others are Kennedy and Eberhart (2001) and Clerc (2006). In this research, a variant of PSO called GLNPSO is used, including the computational library called ET-Lib (Nguyen et al., 2010). This algorithm, similar with other metaheuristics techniques, is actually independent from the problem being solved. In other word, this algorithm can be applied on various problem types. In the PSO methodology, we have to define specific particle representation and decoding method in order to apply PSO for solving specific problem. Particle representation is the definition on how the particle represents the problem, while decoding method is the definition on how the particle can be translated into problem solution. The following subsections define the solution representation and the decoding method for applying PSO for solving the CTOP.

### 2.1 Particle Representation

Based on Ai et al. (2013), particle with dimensions represents a CTOP solution with vertices, in which each particle's dimension corresponds to each vertex, i.e. dimension 1 represents vertex 1, dimension 2 represents vertex 2, and so on. Particle position is assigned to be a real number and represents a priority of vertex on the decoding method. The smaller the position of particle, the higher the priority of the corresponding vertex. Later on the decoding steps, each vertex is evaluated to be inserted into the solution paths based on its priority. Figure 1 illustrates a representation of CTOP with 7 vertices and its conversion process to priority of vertex.

dimension	1	2	3	4	5	6	7
position	0.52	2.69	1.03	0.15	1.94	3.17	1.29

sorted position	0.15	0.52	1.03	1.29	1.94	2.69	3.17
vertex no.	4	1	3	7	5	2	6
priority	1	2	3	4	5	6	7

Figure 1: Solution representation of CTOP with 7 vertices and its conversion to priority of vertex.

## 2.2 Decoding Method 1

The first decoding method is a simple procedure, in which each vertex, one by one based on the priority of vertex, is evaluated to be inserted in the last sequence of each vehicle tour, starting from the first vehicle. If the insertion complies with tour duration and capacity constraints, then the vertex is placed on the sequence. Otherwise, the vertex is evaluated to be inserted to the subsequent tour. If the vertex cannot be inserted to any available tours, it implies that the vertex is decided not to be visited. Figure 2 illustrates tours construction following the first decoding method.

## 2.3 Decoding Method 2

The second decoding method requires more effort than the first one. Instead of evaluating insertion in the last sequence of each tour, this method is evaluating all possible sequence in each existing tour for inserting vertex, one by one based on the priority of vertex. At last, the vertex is being inserted into a sequence in certain tour that satisfies tour duration and vehicle capacity constraints and provides the smallest additional time. Additional time is defined as the difference between the tour duration before and after a vertex is inserted to the tour. Figure 3 illustrates tours construction following the second decoding method.

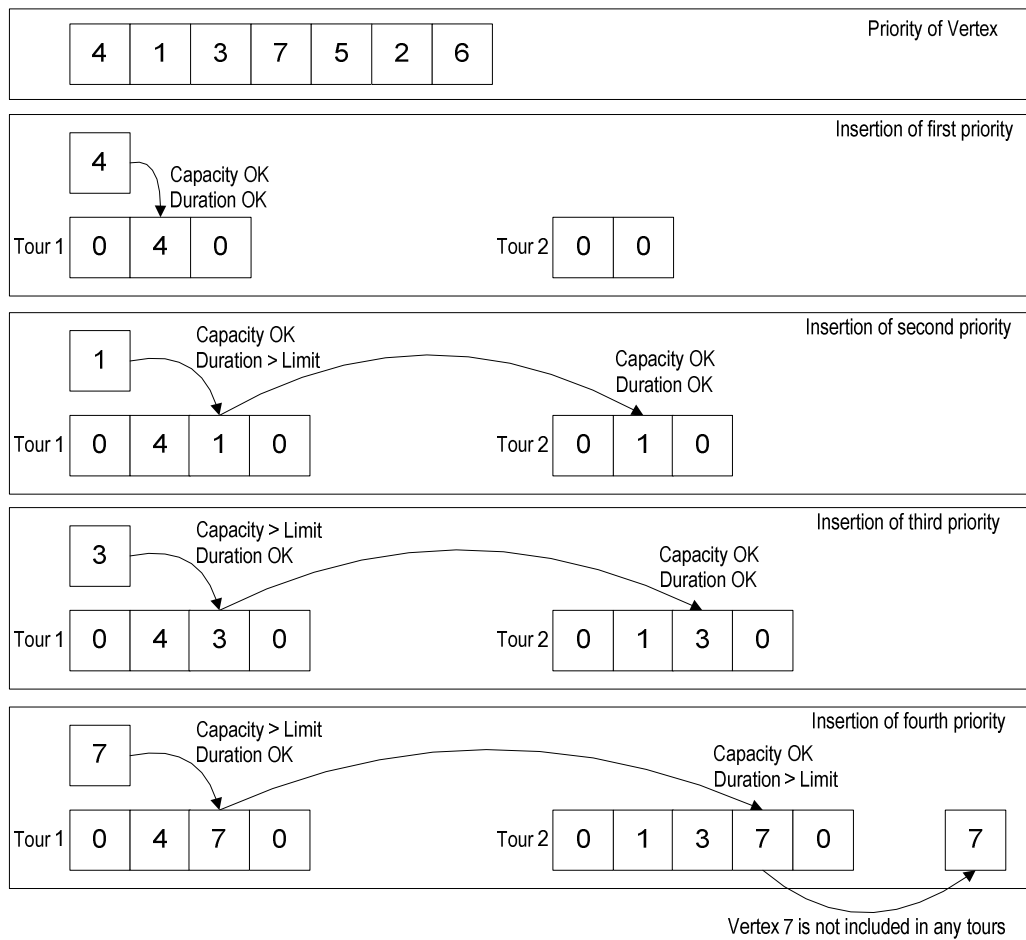


Figure 2: Illustration of tours construction in decoding method 1



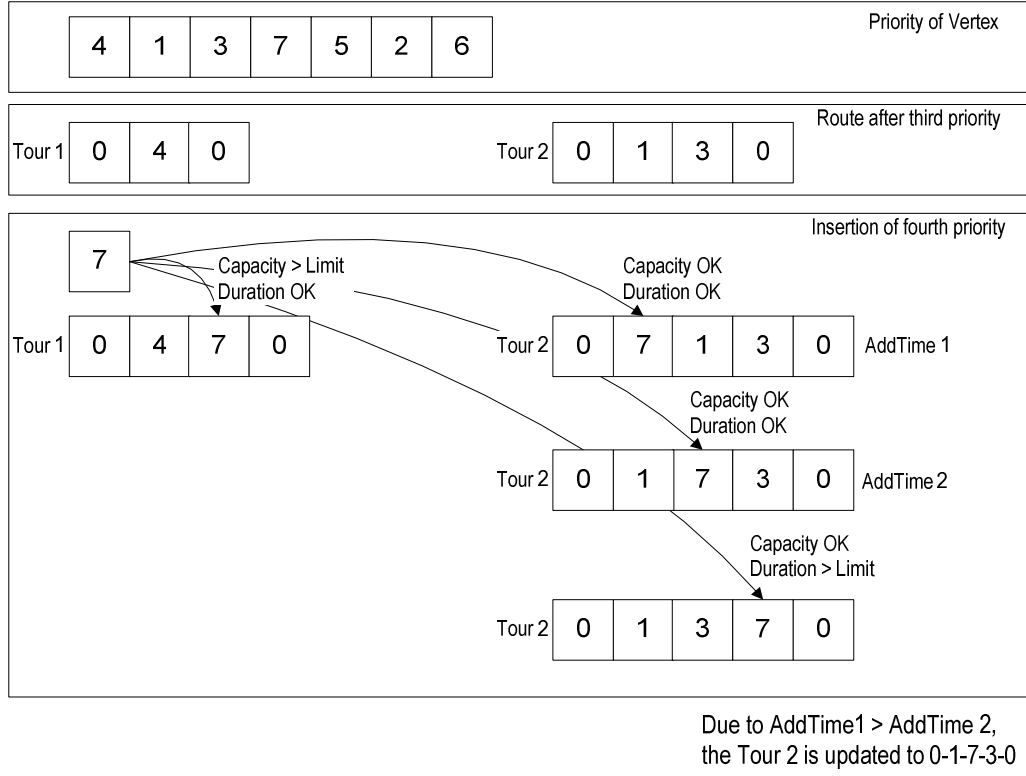


Figure 3: Illustration of tours construction in decoding method 2

### 3. COMPUTATIONAL EXPERIMENTS

The proposed PSO algorithm for CTOP is implemented using C# language assisted with a PSO computational library called ET-Lib (Nguyen et al., 2010). The ET-Lib uses a PSO variant called GLNPSO that has three different social behavior terms called global best, local best, and nearest neighbor best with its corresponding acceleration constant ( $c_g$ ,  $c_l$ , and  $c_n$ ), i.e. the movement of particle in this variant is following these equations:

$$\omega_{lh}(\tau+1) = w(\tau)\omega_{lh}(\tau) + c_p u(\psi_{lh} - \theta_{lh}(\tau)) + c_g u(\psi_{gh} - \theta_{lh}(\tau)) + c_l u(\psi_{lh}^L - \theta_{lh}(\tau)) + c_n u(\psi_{lh}^N - \theta_{lh}(\tau)) \quad (1)$$

$$\theta_{lh}(\tau+1) = \theta_{lh}(\tau) + \omega_{lh}(\tau+1) \quad (2)$$

where  $\tau$  is iteration index,  $l$  is particle index,  $h$  is dimension index,  $u$  is uniform random number in interval  $[0,1]$ ,  $w(\tau)$  is inertia weight in the iteration  $\tau$ ,  $\omega_{lh}$  is velocity of particle  $l$  at the dimension  $h$  in the iteration  $\tau$ ,  $\theta_{lh}$  is position of particle  $l$  at the dimension  $h$  in the iteration  $\tau$ ,  $\psi_{lh}$  is personal best position (pbest) of particle  $l$  at the dimension  $h$ ,  $\psi_{gh}$  is global best position (gbest) at the dimension  $h$ ,  $\psi_{lh}^L$  is local best position of particle  $l$  at the dimension  $h$ ,

and  $\psi_{lh}^N$  is nearest neighbor best position of particle  $l$  at the dimension  $h$ .

The computational experiments are conducted using Archetti et al. (2009) CTOP benchmark data set, which consists of three sets of problem. The first data set or called the original set, which originally taken from Christofides' VRP benchmark data set, consists of 10 problem instances. By modifying the number, capacity, and time limit of vehicles, the second data set are generated consist of 90 different problem instances. While the third data set is generated by modifying the number of vehicles only, which are 30 different problem instances are included in this data set. Therefore, 130 different problem instances are involved in the computational experiments.

A simple experimental design is applied here to select PSO parameters setting. We are varying the value of acceleration constants ( $c_p$ ,  $c_g$ ,  $c_l$ , and  $c_n$ ) among the values of 0, 1, 2; number of particles ( $L$ ) between the values of 30 and 50; and number of iteration ( $T$ ) between the values 200 and 500. Using the problem case p09 in the original set to compare the statistical results in term of solution quality and computational time, we concluded that these settings are the best:  $c_p=1$ ,  $c_g=1$ ,  $c_l=1$ , and  $c_n=1$ ,  $L=30$ , and  $T=500$ .

All the test instances are run on a computer with an Intel Core 2 Duo @ 2.40 GHz CPU and 2 GB RAM. For

each instance, 10 replications of the PSO algorithm runs are conducted.

An experiment is conducted to compare the performance of the Decoding Method 1 and Decoding Method 2 by applying both method for the original set. The best result of obtained from each decoding method are compared in Table 1. It is shown that the Decoding Method 2 is able to find better (higher) profit for four instances (p09, p10, p15, and p16) than Decoding Method 1. While both methods are resulting the same profit for the other instances. It is implied that the Decoding Method 2 is better than Decoding Method 1. Therefore, only the Decoding Method 2 is applied in the subsequent computational experiments.

Table 1: Comparison of profit obtained by each decoding method on original set

Problem Instance					Profit	
No.	$n$	$m$	$Q$	$T$	DM 1	DM 2
p03	101	15	200	200	1409	1409
p06	51	10	160	200	761	761
p07	76	20	140	160	1327	1327
p08	101	15	200	230	1409	1409
p09	151	10	200	200	1674	2058
p10	200	20	200	200	2890	3048
p13	121	15	200	720	1287	1287
p14	101	10	200	1040	1710	1710
p15	151	15	200	200	2035	2129
p16	200	15	200	200	2920	3070

Table 2 presents the comparison of the Decoding Method 2 results with the Branch & Price of Archetti et al. (2009) over the original set. All the profit obtained by each methods are presented under the  $P$  column. The BK column shows the best known solution of each corresponding instances obtained by any other methods, after Archetti et al. (2009). The CPU column shows the computational time of each method in seconds. In the Branch & Price results, the sign ‘-’ indicates that the computational time is exceeded 3600 seconds and the algorithm is terminated at that time limit. The percentage deviation of a method ( $P$ ) from its correspondence best known solution ( $P_{BKS}$ ), which is indicated as  $\%D$ , is calculated by following equation:

$$\%D = \frac{P_{BKS} - P}{P_{BKS}} \times 100\% \quad (3)$$

Table 2: Comparison of profit obtained by each decoding method on original set

No.	BK	Branch & Price			PSO with DM 2		
	$P$	$P$	CPU	$\%D$	$P$	CPU	$\%D$
p03	1409	1409	41	0	1409	5.89	0
p06	761	761	2	0	761	1.84	0
p07	1327	1327	2	0	1327	3.67	0
p08	1409	1409	17	0	1409	5.23	0
p09	2064	1164	–	43.6	2058	7.96	0.29
p10	3048	1735	–	43.08	3048	13.3	0
p13	1287	1287	21	0	1287	5.98	0
p14	1710	1710	1082	0	1710	3.84	0
p15	2159	2159	1866	0	2129	9.25	1.39
p16	2968	588	–	80.19	3070	13.5	-3.44
Average		1355		16.69	1821		-0.18

It is shown in Table 2 from the  $\%D$  column for PSO that there are one negative value, 7 zero values, and 2 positive values. Negative value of  $\%D$  indicates that the PSO result is outperformed existing best known solution, zero value of  $\%D$  indicates that the PSO result is similar with existing best known solution, and positive value of  $\%D$  indicates that the PSO result is worse than existing best known solution. To have a single criteria for comparison, the average of  $\%D$  is also calculated. Based on this criteria, we can easily conclude that the PSO with DM 2 is able to provide better result than Branch & Price method.

The results of PSO with DM 2 over three data set are summarized in Table 3. It is shown that PSO is able to solve CTOP with results that are very close to the existing best known solution, i.e. the average percentage deviation for all data set is less than 1%. The proposed PSO is also able to provide 47 among 130 solution of instances that are similar with its corresponding best known solution. In addition, the PSO is able to result one solution of instance, which is p16 in the original set, outperforming its existing best known solution.

Table 3: Summary of PSO results

Data Set	Original	Second	Third
Average $\%D$	-0.18	0.60	0.73
Average CPU (s)	7.04	3.98	8.32
$\%D = 0$	7	37	3
$\%D < 0$	1	0	0

#### 4. CONCLUDING REMARK

This paper is successfully presented that PSO is also able to solve the CTOP, especially using proposed Decoding Method 2. The computational results show that the proposed PSO algorithm is able to obtain 47 best known solutions of 130 benchmark problems and to improve 1 best known solution, while in average the percentage deviation for all data set is less than 1%.

#### ACKNOWLEDGMENT

The authors express thanks to High Performance Computing Group at Asian Institute of Technology, Thailand, for providing the Object Library for Evolutionary Techniques (ET-Lib) version 1.0 used in the preparation of this paper.

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